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Civil Engineering.

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Description of the Wooden Aqueduct carrying the Pennsylvania Canal across the river Alleghany, at Pittsburg; from actual measurement. With remarks by JOHN C. TRAUTWINE, *Civil Engineer.*

This aqueduct was built in the year 1829, by Mr. Lothrop of Pittsburg, at an expense to the State of $104,000. It has two abutments, six piers, of stone, and seven arches of timber, of 150 feet clear span each; the whole length of the aqueduct between the abutments being 1092 feet. The masonry is of cut ashlar, in large courses, with rubble filling. The material is a gray sandstone, rather too soft, in my opinion, for such parts of a structure as are exposed to rapid currents, bringing down heavy fields of ice and drift wood, as is the case with the Alleghany. *The piers are seven feet thick on top;* they batter one inch to a foot, on the sides; are semi-circular at their down-stream ends; and are provided (at least those of them which are exposed to the principal force of the current,) with *breakwater* starlings, of this shape, up-stream. (This term is frequently applied to such starlings, but I cannot perceive its propriety; the expression savors of tautology.) The average height of the piers is about forty feet.

The timber of the aqueduct is white pine, with the exception of the *chords* and the *pier-posts*, which are of white oak, as being better calculated to resist the great strains that come upon them. I conceive, however, that any precaution of this kind would apply with more

force to the *pole plates*, or cap-pieces, as it is well known that the resistance of timber to compression is much less than that to extension. Therefore, if extra precautions are requisite for the chords, they are doubly so for the poles.

The width of the aqueduct, from out to out of weather boarding, is about thirty-four feet. The height of the trusses, from bottom of chords to top of poles, sixteen feet. The canal trunk has a top width of sixteen feet, a bottom width of fifteen feet, and a depth of five feet. The depth of water is generally four feet; sometimes four feet three inches. There are four trusses to each span. These particulars, however, with the other principal dimensions, are so plainly indicated by the drawings, as to require no further explanation. Throughout the drawings, *the same letters refer to the same parts.*

Table of Scantlings of the Principal Timbers and Irons.

Names of pieces.	References.	Remarks.	Inches.
Arch pieces, . .	L	six to each truss, or composing each rib; each piece . . .	7×14
Pole, or cap, .	J	of inner trusses, . . .	10×15
" " " . .	F	of outer trusses, . . .	10×12
Chords, . .	C	of both inner and other trusses, each in two pieces; each piece . .	7×15
Queen posts, . .	Q	in body, . . .	9×10
" " .	"	in heads and feet, . .	10×14
Main braces, . .	S	. . . .	8×10
Counter braces, .	X	. . . .	8×4½
Butting pieces, .	P	at heads of queen posts of outer trusses,	5× 7
" " .	T	or straining pieces at heads of queen posts of inner trusses, . .	5× 7
Diagonal braces, .	U	in roof, and under canal trunk, .	6× 7
Extra braces, .	M	on outer trusses only . .	6×12
Straining sills to ditto,	*k*	. . . .	6×10
Straining pieces to "	*f*	. . . .	6×12
Straining sills to pier posts,	*j*	. . . .	6×10
Fishing pieces to poles,	*b*	over piers, . . .	6×12
Roof girders, . .	E	. . . .	7×12
Floor girders, .	G & H	. . . .	9×18
Additional pieces, .	A	under girders marked G only, .	9×15
Plank , .		of footway, towpath, and canal trunk, thickness	3
Weather boarding, .	N	. . . . "	¾
Iron suspending rods,	R	. . . .	1¼diam

Screw bolts, 1 inch square; spikes for planking of canal trunk, ¼ inch square; spikes at heads and feet of braces, ¼ inch square.

In figure 1 it will be seen that the tops of the lower girders are not all in the same horizontal line, but that every other one, H, is raised about one foot above the intermediate ones, G. When the aqueduct was first built, only one of these sets of girders was employed, being supposed sufficient to sustain the weight of water in the trunk. Their distance apart was about ten feet in the clear. But when the water

was let into the trunk, the girders began to yield under a head of about three feet, and it was found necessary to double their number, and moreover to bolt, or rather stirrup, to every alternate one, viz: those marked G, an additional under-girder, A, fig. 2, 3, 4.

The reason for thus alternately raising and depressing these lower girders was, to permit the passage of the two courses of lower diagonal braces from one H to another, over G, (see fig. 9, and also the dotted lines *a*, *a*, *a*, in fig. 3.) Where the H's cross the inner chords, (which are lower than the outer ones,) they are made to bear on them, by means of the blocks *h*, *h*, fig. 3. These blocks are not shown in the transverse section, it being supposed to be taken near one of the girders, G. Over the girders, G, are seen (fig. 3,) blocks O, O, marked in dotted lines; there are transverse timbers, resting on G, and helping to support the flooring plank of the canal trunk, as there are no longitudinal joists in the aqueduct. The pieces O, do not interfere with the diagonal braces, merely running from each inner chord to the braces.

The floor of the trunk rests only on the upper course of diagonal braces, on the transverse pieces, O, and on the raised girders, H.

Each girder, H, and G, is sustained by the two inner chords, and by four suspending rods of iron, one and a half inches in diameter, of which two are shown in fig. 4, by R, R. In the outer trusses, the tops of these rods bear on the tops of the arches, or curved ribs, (see fig. 1,) by means of wooden saddle pieces, D, figs. 3, 4. In the inner trusses, they bear upon the tops of the poles, or caps, and are covered by a longitudinal capping piece, of 3 inches thickness, (*m*, fig. 4:) this capping is rounded off at top, so as to prevent the chafing of the tow-rope.

To bring the bearing of the suspending rods more equally on all the arch-pieces, blocks are inserted between the arch-pieces, vertically, at the place of each rod, as shown in fig. 3. M, M, in fig. 1, are extra braces, employed only in the outer trusses; *k*, *k*, are their straining-sills. At their upper ends they abut against short pieces of 6 × 12 (*f*, *f*,) firmly bolted to the poles. These extra braces are in pairs, being on both sides of the poles.

j, *j*, fig. 1, are the straining sills for the pier braces, S, S, serving to stiffen the pier posts; see fig. 6, which also shows the cast iron abutment plates, *g*, *g*, for receiving the feet of the curved ribs. They are merely flat plates, three feet eight inches deep, two feet wide, two inches thick, and without any flanches. The recess in the pieces, for receiving the feet of the ribs, and pier posts, is but eight inches deep. See also fig. 2.

P, figs. 3, 4, are the short butting-pieces for relieving the heads of the

queen posts from the action of the main braces. In the inner trusses, instead of these short butting-pieces, long straining-pieces, reaching from one post to another, are used, T, figs. 3, 4. T is represented in fig. 3, to save the trouble of another engraving.

The suspending rods are about five feet apart; but it is seen in fig. 1 that these rods stop short within some fifteen feet of the piers, because the curve of the ribs in that interval would not allow of the passage of girders past them. In this interval, therefore, the ends of the girders are supported by pieces, K, fig. 7, bolted to the ribs.

s, *s*, figs. 2 and 4, are uprights, placed four feet apart, for spiking the side planking of the canal trunk to; at their heads they tenon into a continuous cap-piece, *v*, and at their feet they tenon between the strings *e* and *n*. *n*, and the blocks *t*, being supported by the queens, prevent *s* from spreading outwards.

Where the curve of the arches comes below the line of *t*, the latter is dispensed with, and *v* rests against the arches themselves.

r, *r*, are two pieces, of 3 × 6 inches, spiked to the queens, for receiving the floor plank of the tow-path, on one side, and of the footway for ordinary purposes, on the other.

The roof is boarded and shingled.

Where the tops of the inner arches get below the line of the tow-path floor, a piece of plank, on edge, resting on the floor, is nailed against the queens, to prevent horses from slipping into the canal trunk.

Fig. 5 shows an excellent device for counteracting, to some extent, the tendency which trusses always have to settle in the centre. The poles, or caps of the adjoining arches, are here connected by fishing splices, each composed of two pieces of 4 × 12, well bolted, and tree-nailed together, through the caps; and as a further security, two blocks, *z*, *z*, of hard wood, about four inches square, are driven through, from side to side. By the introduction of these splices, it is obvious that the inward draw of two adjoining trusses is mutually counteracted to a considerable extent. This arrangement, together with the extra braces, serves very much to stiffen the trusses; and something of the kind should always be resorted to in large spans.

Fig. 8 shows the mode of scarfing the pieces composing the curved ribs. These pieces break joint where the ribs pass the queens, so that the bolts of the scarfs pass entirely through the queens, and the rib pieces on each side of them. The scarf of the poles is shown in fig. 3; that of the chords is the same as that of the poles, only that which constitutes the side view of the pole scarf, forms the top, or plan, of that of the chord.

Fig. 11. As it is always a matter of importance in a bridge erect-

ed over a stream liable to freshets, to secure each span as soon as possible, so as to stand in case the scaffold should happen to be carried away; the introduction of the secondary timbers is generally deferred until those essential to the support of the bridge, in such an event, are put together. Therefore, the diagonal braces are not inserted until after the girders are put into their places.

As these braces are tenoned into the girders at both ends, they could not be inserted into the mortises in the girders, unless some *play* were allowed at one end; this play is afterwards filled up by a pair of double wedges, as shown in fig. 11.

Where the counterbraces of the trusses intersect the main braces, the former are merely tenoned into the latter, as shown in fig. 3, at Y. Where the chords and queens intersect, they are notched equally into each other, so as to bring the two pieces composing the chords within about an inch of each other, figs. 2 and 4.

The planking of the canal trunk is single, and well caulked. The courses of plank are from six to fifteen inches wide.

Remarks.—This aqueduct evinces, more strikingly than any other structure I know of, the capability of timber for the purpose of bridge building. The weight of water in the canal trunk on a single span, when four feet three inches deep, amounts to 275 tons, of 2240 lbs.; and we may safely say that that weight is frequently increased to at least 300 tons, during the passage of boats; for although a boat, of course, displaces a bulk of water of equal weight with herself, yet it may readily be conceived that the water so displaced does not instantaneously leave the span, on her entrance; and I think we may assume that at least twenty-five tons of it are frequently on a span at the same moment with the boat. Yet on a most critical examination, made with that view, I could not detect in any part of the timbers the slightest symptom of what might with propriety be called *crushing*. Slight *compressions*, (if I may be allowed to draw such a distinction,) were visible at the heads of the queen-posts, but not to a greater extent, apparently, than invariably attends all trusses of this kind in common bridges of large spans, after having been some time in use. In all bridges there is a tendency to settle, or sag, in the centre; and this tendency, of course, brings a heavy compressing strain upon the pole plates; but beside *this* compression, incident to the truss considered *as a whole*, there is *another*, acting at the several points at which the heads of the posts tenon into the poles. This compound compression explains a fact for which I was for some time at a loss to assign a satisfactory reason. I have already stated that in the *inner* trusses of this aqueduct, a straining-piece, like that shown at T, fig. 3, was inserted between the heads of the posts, in

preference to the short butting piece, P, figs. 3, 5, employed in the outer trusses. This was evidently done under the impression that it opposed a more perfect resistance to the compressions alluded to, than the shorter pieces; and, at first sight, it will probably strike most of my readers in the same manner. But it is of great importance to know, that although the long piece is almost invariably introduced, both by engineers and bridge builders, whenever extraordinary compression of the pole is anticipated, it is in fact *entirely ineffective:* whereas the short butting pieces perform the duty assigned them perfectly.

I shall endeavor to point out the cause of this.

The compression of the poles evidently increases from the piers towards the centre of the span, in the same manner as in a single long piece of timber, supported at two ends, when it sags in the middle: consequently, when the bridge settles, as it always will, more or less, the head of any one post is moved a greater distance towards the centre of the span than the post behind it, that is, between it and a pier. Therefore, the opening, p', behind the post, Q', must be a little wider than the opening p, behind the post Q; and, consequently, the inner end of the straining-piece, T, cannot be forced up into contact with the head of the post Q, but must remain distant from it an amount equal to the difference of the compression which takes place in that part of the pole between Q' and the centre of the span, and that part which extends from p' to p. This difference in the amount of compression between any two consecutive posts, is very perceptible in all large bridges, being generally about one-eighth of an inch, that is if there be seven spaces in the truss, between a pier and a king post, the opening at the inner one will generally be about seven-eighths of an inch, at the next one six-eighths, at the next five-eighths, and so on to the queen post near the pier, where it will diminish to nothing. In some bridges, and those excellent ones, I have seen the openings behind the queen posts much greater than this, at least double; but, I believe, only in such bridges as have no chords to confine the feet of the ribs. Of course some portion of these openings, in every case, is due to the compression which takes place in the heads of the posts themselves. This is frequently very perceptible. I could just detect it in a few of the queen posts of the aqueduct.

But it may be objected that if the explanation I have given be correct, then even the short butting piece, P, should also be ineffective; because, if the compression of the pole increases so perceptibly towards the centre, then supposing the length of the butting-piece to be one-fourth of the distance between two queens, the inner end of the butting-piece should not come into contact with the pole, by an

amount equal to one-fourth of the opening which occurs between those two queens. Plausible as this deduction would seem, it is, nevertheless, incorrect, for as I have before remarked, the short butting-pieces act admirably, and, as I conceive, for this reason, that although the entire length of that portion of a pole, or cap, between two adjacent posts, is in a state of compression, which, considering the whole truss as one great beam, gradually increases towards the centre. Still the action of the main braces against the back part of the head of each post, tends to bring an additional strain upon the portion of the pole next adjoining the *inside* of the post head. This additional strain produces a compression of its own, which, unlike that operating on the truss considered as a whole, *decreases* towards the centre. Therefore, that part of the pole into which the head of any post tenons, is more compressed than the part at the end of the butting-piece, and, consequently, the latter is brought into full action.

This matter is a very important one, and my remarks on it were suggested by seeing that in this aqueduct the long straining-piece had superseded the short butting-piece, evidently in expectation of its greater efficiency. In the Market street bridge, at Philadelphia, the finest in existence, the same defect exists; also in the viaduct of the Columbia and Philadelphia Railroad, near Philadelphia, and many others, built by the most talented and experienced bridge builders in the country.

But in all these bridges, as well as in this aqueduct, the inner ends of none of these long straining-pieces are in contact with the heads of the adjoining posts, against which they were intended to exert a powerful compression. Consequently, they are not only useless, but positively injurious, as they add unnecessarily to the weight of the truss, and thus absolutely *increase* that tendency to settle, which they are intended to prevent.

I noticed a splintering, or spalling off, of the stones supporting the feet of some of the arches. The stones in this part of a bridge, as well as those forming the facing of the starlings, should always be of good quality; and, in the former case especially, attention should be paid to their *toughness;* soft sandstone should never be admitted.

In an extreme case like this, of such an immense weight and so soft a stone, or indeed with stone of the best quality, I should certainly prefer to have the recesses in the top of the pier for receiving the feet of the curved ribs and pier posts, somewhat deeper than in this instance, where they are but eight inches deep, figs. 1, 2, and 6. The pressure on the piers and abutments, so long as the bridge maintains itself, is almost altogether vertical, and as it sometimes happens that the bearing is not very fair, every precaution should be used to pre-

vent spalling. One of the spans, at the time I saw the aqueduct, was (in my opinion,) in imminent danger of falling, in consequence of this.

I am confident that two trusses, instead of four, would have been sufficient to support the trunk of this aqueduct, especially if another arch-piece had been added to the depth of the curved ribs, and the height of the trusses made a little greater. This additional height would, moreover, have added to the convenience of passengers on the roofs of the boats, who are now obliged to stoop in passing through the aqueduct. As the use of but two trusses would, of course, increase the clear width between them, to admit the tow-path, the girders might be trussed by a heavy arch-piece, which would insure abundant strength. A considerable diminution of expense would attend such an arrangement.

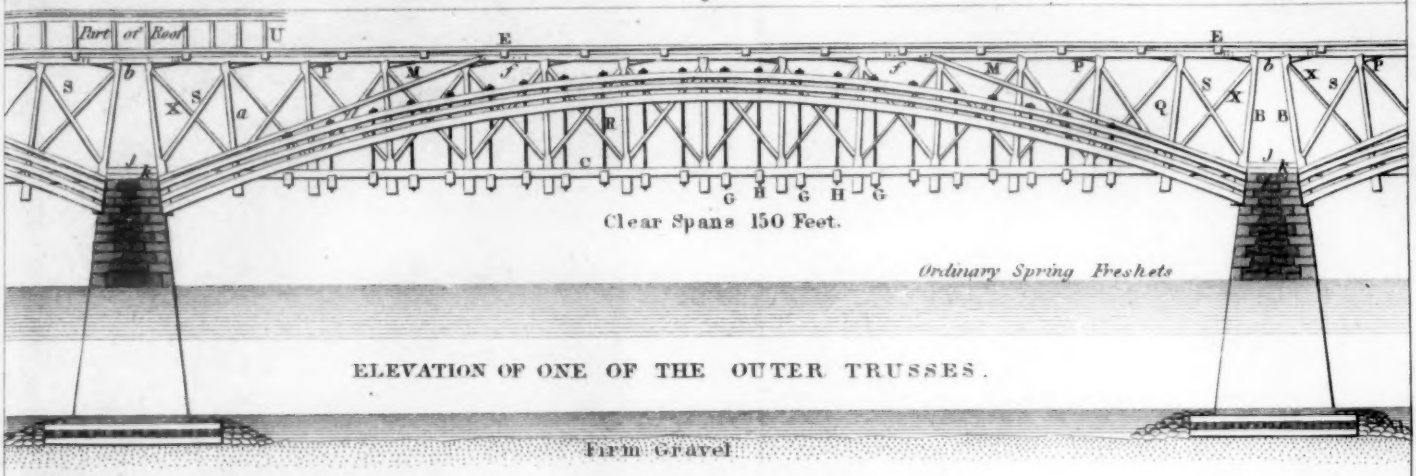
As to the piers of this aqueduct, they are, as before stated, *but seven feet thick on top*, or $\frac{1}{21.43}$ part of the span; or not quite *one-half as great* as the proportion of those used in the Trenton bridge, which is the boldest one cited by Tredgold, in his table of stone piers for wooden bridges.

I am by no means prepared to advocate the *breakwater* starling, (so called,) used in this aqueduct, and in many large bridges in the country. I have known them to pitch very heavy blocks of ice upon the roof, and outside footways of the bridges to which they were attached. This never occurs with semi-circular starlings, and as I have never known one of the latter shape to be injured when built with care, I consider it preferable to the other—though I think something like a semi-ellipse still better. My own practice is to batter the fronts of the starlings two inches to a foot, and work them into one inch to a foot, as they approach the sides of the piers. Experience has given me every reason to be satisfied with this shape. In very exposed situations, there would be no objection to increasing the front batter to considerably more than two inches to a foot.

The foundations of the piers of the aqueduct do not appear to have settled in the least, or to have undergone any derangement; still, even in the face of this precedent, I should certainly prefer the foundation to be laid at the depth of a few feet below the bottom, in structures so important as this. There are, however, several bridges across the Alleghany, in the vicinity of the aqueduct, and all their piers are founded in this manner, (some of them, indeed, having but one course of timbers in their platforms,) which is strong evidence of the sufficiency of the plan, on a gravel bottom, even when exposed to tremendous freshets.

Viewed as a whole, this aqueduct, for which, I am under the impression, there was no precedent, certainly reflects the highest credit

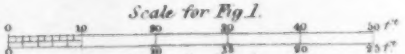
Fig 1. Peak of Roof



ELEVATION OF ONE OF THE OUTER TRUSSES.

Firm Gravel

Scale for Fig 1.



Scale for Fig 2.

Fig. 4.

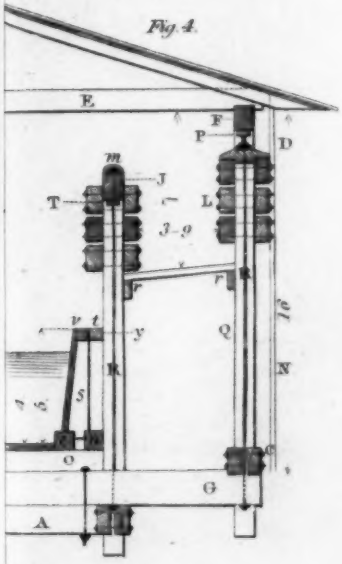
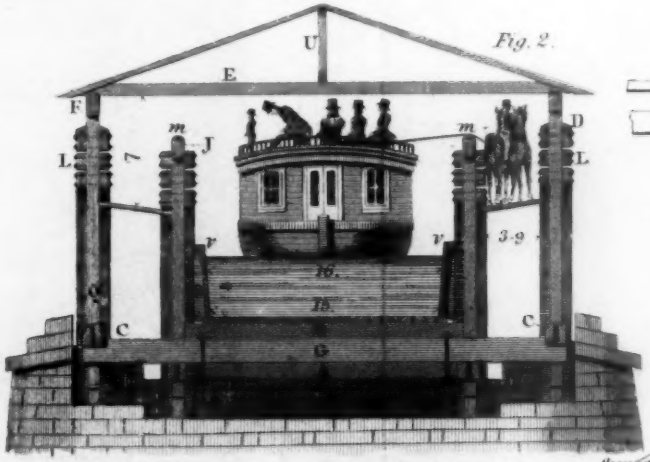


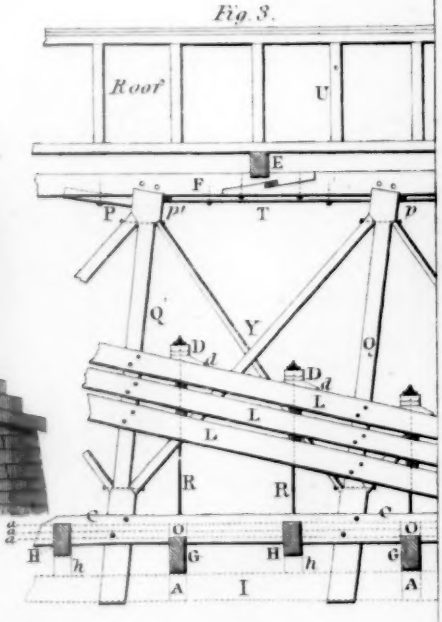
Fig. 2.

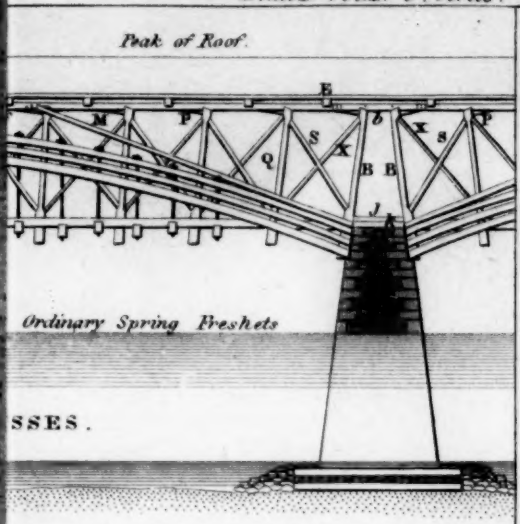


TRANSVERSE SECTION OF AQUEDUCT,
Taken at centre of a Span.

Scale for Figs 3 4 5 6.

Fig. 3.




Peak of Roof.
E
M
P
S
Q
X
b
B B
J
Ordinary Spring Freshets

SSES.

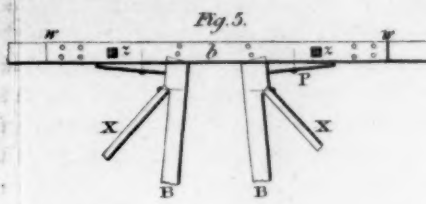
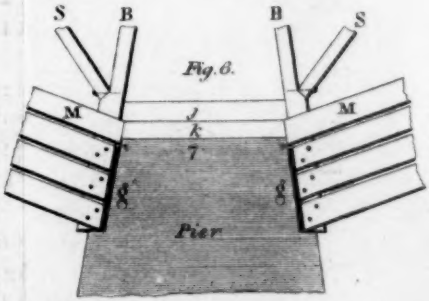


Fig. 5.
W
b
P
X
B
B


S
B
B
S
Fig. 6.
M
J
k
7
M
g
g
Pier

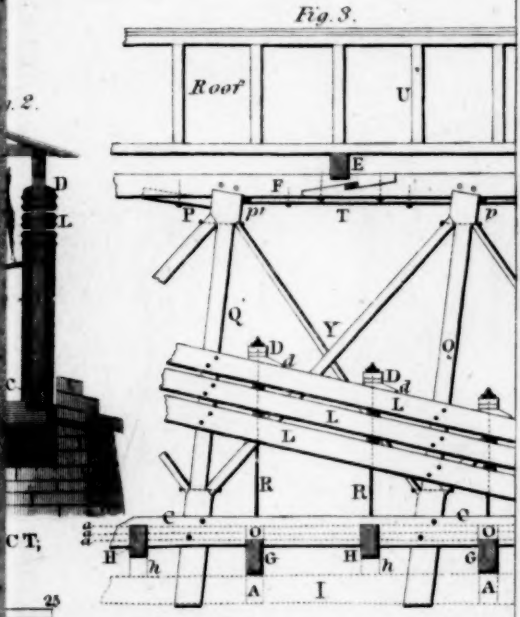
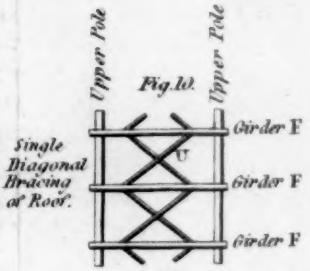
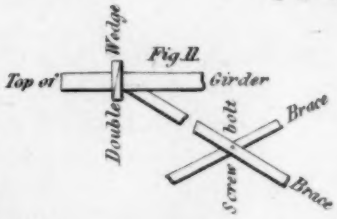


Fig. 3.
Roof
U
E
F
P
p'
T
p
Q
Y
D
d
L
R
e
O
H
h
G
A
I

D
L
C
CT;
25


Upper Pole
Upper Pole
Fig. 10.
Single Diagonal Bracing of Roof.
U
Girder F
Girder F
Girder F

Chord C
Chord I
Fig
O
G


Wedge
Fig. 11.
Top of
Girder
Double
Screw bolt
Brace
Brace

Z
W
X

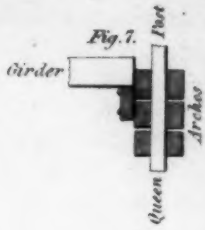


Fig.7.
Girder
Post
Arches
Queen

S
M

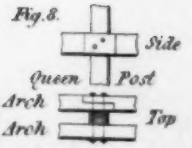
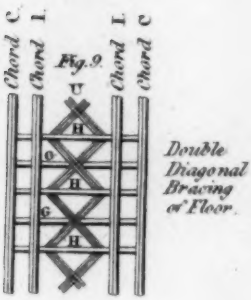


Fig.8.
Side
Queen
Post
Arch
Arch
Top


Chord
Chord
Fig.9.
Chord
Chord
U
H
G
H
G
H
Double
Diagonal
Bracing
of Floor.

der
Brace
Brace

on Mr. Lothrop, for boldness and mechanical skill.* There are others, of much the same kind, on the canal; all, I believe, designed by him. The general arrangement of the timbers is not original with him, having been long before practised, in very many instances, in common bridges; but the application of it to the purposes of so extensive an aqueduct, was certainly a very bold step; and its entire success is proof of an intimate knowledge of what he undertook.

I look upon this arrangement of timbers as the best yet devised for large spans. It certainly admits of many improvements in its details, and from some experiments of my own on the subject, I am under the impression that considerable modifications in some of the more important parts, might be made with advantage. I may take occasion, in some future paper, to allude to them.

The curved rib, it is well known, *is stronger* in the centre than at any other point; or, in other words, a load, which, applied between the centre and one of the piers, would destroy the rib, might be supported, with perfect safety, in its centre. But the truss which is connected with the ribs, *is weaker* in the centre than at any other point; its resistance to a load acting at any point, being, as in the case of a single piece of timber, proportional to the rectangle of the distances from the point at which the load is applied to the points of support. *Therefore, the combination of the curved rib with the truss, secures a more uniform degree of strength throughout the whole span, than could be attained by either one, used separately.*

But besides this, another very important consideration attends the combination of the curved rib with the truss, viz: that each not only contributes its own share to the support of the load, but actually *increases the power of resistance of the other*—that is, the two combined will support a greater load than they could separately, were the load divided between them. A curved rib, when employed by itself, is very weak at the haunches, and readily yields to a load applied there; but if proper means be adopted for preventing the rib from *changing its form*, its strength is wonderfully increased, indeed to such an extent that actual crushing of the timber must take place before the rib will yield to its load. Without this precaution, its flex-

* We think it proper to remark here, that in the sixth volume of the London Repertory of Arts, p. 220, is detailed at length, the specification of a patent taken out in England, in 1796, by Mr. James Jordan, *for constructing aqueducts and bridges, with curved ribs of timber, or iron, and suspending therefrom, by iron rods, the floor or trunk, as the case may be.* The celebrated bridge over the Delaware, at Trenton, commenced in 1804, is, in its general outline, almost a precise copy of the plate illustrating Jordan's patent, in the Repertory of Arts, and is, in principle, unquestionably, *an infringement of that patent.* Mr. Jordan also gives a plate of a projected aqueduct, precisely the same in its essential principles as that which forms the subject of the above paper. Com. Pub.

ibility will permit it to bend, and fall through between its abutments, under a load many times less than that necessary to *crush* it. *Such a change of form, or bending, is prevented by the truss,* and thereby so great an accession of strength is imparted to the rib, that if we could conceive of the truss acting only in this capacity of a stiffener to the rib, without itself sustaining any portion of the load, still the strength of the bridge would be increased many fold. I have seen curved ribs of 200 feet span, bend, and fall into the river, between their abutments.

The highest known freshet of the Alleghany, rose to about the floor line of the canal trunk; the weather boarding of the outside formed a kind of dam, against which, trees, barns, houses, &c., accumulated, until they formed a wide field of drift on its upper side. A large concourse of people stood on the banks of the river, expecting to see the whole structure lifted off from its piers, and floated away; but it stood perfectly firm, and I believe sustained no injury whatever.

It is my intention to endeavor, through the medium of the Journal, to supply, in some measure, a deficiency that exists in all our works on carpentry, in that department which treats of the spanning of large openings. The best mode of doing this will, probably, be to present to the reader a series of papers, descriptive of existing structures, with such comments as may happen at the time of writing, to be suggested by the particular example under consideration. This paper may be looked upon as the first of the series, and I shall endeavor to follow it up, as my leisure permits, by other interesting examples of such works as have come under my own immediate notice. In some future paper I shall enlarge more fully upon the several individual timbers composing such a truss as that employed in this aqueduct. The subject of wooden bridges, of large spans, is a very interesting and important one, and one of considerable intricacy. Its importance has of late been much enhanced, by the discoveries of preservatives of timber from decay. Should an equally effective preservative against fire be discovered, which, under the present rapidly increasing discoveries in chemistry, is not at all improbable, we should have much less reason than at present to regret our national want of fine stone bridges.

Athens, Tennessee, May, 1842.

Mode of Tracing a Curve of very large Radius, adopted in the Survey of the Northern Boundary of the State of Delaware, in 1701.

Professor JOHN F. FRAZER has deposited at the Hall of the Franklin Institute, in Philadelphia, some interesting documents, concerning the original demarcation of the curvilinear boundary, dividing the northern part of the State of Delaware from the conterminous States of Pennsylvania and Maryland. These documents consist,

I. Of the original warrant by William Penn as "Proprietary and Governor of Pennsylvania and the counties annexed;" bearing date the 28th day of the 8th month, 1701, and directed to Isaac Taylor, of the county of Chester, in the province of Pennsylvania, and Thomas Pierson, of the county of Newcastle, "*in the territories;*" instructing them to accompany the magistrates of each county, or any three of them, within the space of forty days after date, and in their presence to admeasure, and survey, a circular boundary line, struck by *a radius of twelve miles,* from the town of New Castle, as a centre; the line to be well marked, and to consist of "*two-thirds of a semi-circle of twelve miles radius.*"

II. Of a duplicate record of the official proceedings of the appointed surveyors, and the field notes of the survey, made pursuant to the aforesaid warrant, in the presence of six magistrates—three of the province of Pennsylvania, and three of the "*annexed territories,*" now the state of Delaware.

By this document it appears that the centre of the arc of the circle, or the point of beginning the radial line, was established by the magistrates "at the end of the horse dike next to the town of New Castle," thence by various courses, *rectified to a due north line,* the surveyors ran off *the radius of twelve miles,* terminating at a white oak tree, in a sinuosity of the Brandywine Creek; and as it will probably be more interesting, we subjoin an extract from the official memoir, in which the surveyors (in their own language,) give a brief account of their operations, in first tracing a radius of twelve miles, *due north,* and then marking out the required segment of 120°, by uniform angles of deflection from primary chords, *as is at this day practised* upon railroads, and similar works.

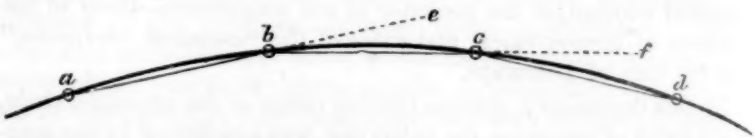
Extract from the Surveyor's Memoir.

"The 26th day of the 9th month we did begin, in the presence of the said justices (Cornelius Empson, Richard Halliwell, John Richardson, Caleb Pusey, Philip Roman, and Robert Pyle, Esquires,) at the end of the horse dike, and measured due north twelve miles, to a white oak, marked with twelve notches, standing on the west side of

Brandywine Creek, in the land of Samuel Helm; and from the said white oak we ran eastward, circularly, changing our course from the east southward, one degree at the end of every sixty-seven perches, *which is the chord of one degree to a twelve miles radius;* and at the end of forty-three chords we came to the Delaware river, on the upper side of Nathaniel Sampley's old house, at Chichester; and then we returned to the said white oak in Israel Helm's land, and from thence we ran westward, changing our course one degree from the west southward, at the end of every sixty-seven perches, as before, until we had extended seventy-seven chords, (which being added to the forty-three chords, make two-third parts of the semi-circle to a twelve mile radius,) all which said circular line being well marked with three notches on each side of the trees, to a marked hickory, standing near the western branch of Christiana Creek. Surveyed the 4th day of the 10th month, 1701, by us."

(Signed) ISAAC TAYLOR,
THOS. PIERSON.

To elucidate more fully the principles involved in this demarcation, we subjoin a diagram (on a scale necessarily distorted,) showing three of the chords assumed at random from the eastern part of the survey.



Uniform length of each chord = nat. sin. $\frac{1}{2}°$ × 12 miles, rad. × 2 or .008726 × 3840 perches × 2 = 67.01952 perches, *say* 67 *pers.*, which is the chord of 1° of a circular arc, of the radius fixed; as is correctly stated in the surveyors' memoir.

Chords, { *a b* = S. 79° E. 67 pers. / *b c* = S. 78° E. do. / *c d* = S. 77° E. do. } Angles of deflection, *e b c*, *f c d*, &c. uniformly 1°.

The surveyors began their field labors on the 26th day of the 9th month, 1701, and closed them on the 4th day of the 10th month, having occupied but nine days in the work; running, within that time, twelve miles of radius, and twenty-five and one-eighth miles of chords of the curve—in all upwards of thirty-seven miles, or more than four miles surveyed and measured each day, at an average.

When we consider the care required in tracing the chords by rectified courses, and the obstacles which the face of the country must then have presented, *this was rapid work;* and it stands forth in striking contrast to the vast length of time, which similar geodesic operations are at this day made to consume.

It will be obvious to all who are conversant with matters of this nature, that the mode adopted in 1701, by these surveyors, *in tracing this arc of twenty-five miles long*, upon a radius of twelve miles, *is in substance the same* as that so generally used at the present time in marking out upon the ground the large circular curves of railroads, in which—as in the case of this boundary line—the centres are at an inconvenient distance.

The main principle involved is, *that of deflecting a constant angle in passing from one chord to another of equal length;* by which process a number of points in a circular arc may be correctly established, by the salient angles of the inscribed polygon, as is easily shown from the geometry of curves.

In railroad surveys the primary chord is usually assumed at the fixed length of one hundred feet for all curves, (instead of sixty-seven perches, as adopted in this case, to make the uniform angle of deflection 1°;) and the angle of deflection between the chords is, for any given curve, made proportional to its radius, as must necessarily be the case when the chord employed is of a constant length: still the principle involved, as well as the mode of operating with the circumferentor, is precisely the same in marking out a railway curve, as was employed by Messrs. Taylor and Pierson, in the trace of the circular boundary line above described, and which is highly creditable to them, as a practical operation, performed with the most simple instruments.

The idea has been generally entertained that Lieut. Col. Long, of the United States Corps of Engineers, was amongst the first to deduce from the geometry of curves, and to apply, practically, the mode of tracing circular arcs of large radius, to which we have just referred; and in a little work published in Baltimore, in 1829, entitled the *Railroad Manual*, which has become amongst engineers a text book of curvature; Col. Long developed in a very perspicuous manner, all the principles necessary to the demarcation of great curves, by means of primary chords of one hundred feet; as well as to enable the inscription within the primary arcs, of a decimal system of sub-chords; but from what we have said above, it would appear that in the main features of the process he had been anticipated, as long ago as the year 1701, by Messrs. Taylor and Pierson, the surveyors of the circular boundary line of Delaware.

Before closing this subject, we must remark that, although the boundary surveyors clearly developed the plan of tracing a large arc of a circle, *by constant angles of deflection between primary chords of equal length*, so as to be geometrically correct; nevertheless it is singular that, in applying these principles upon the ground, they have

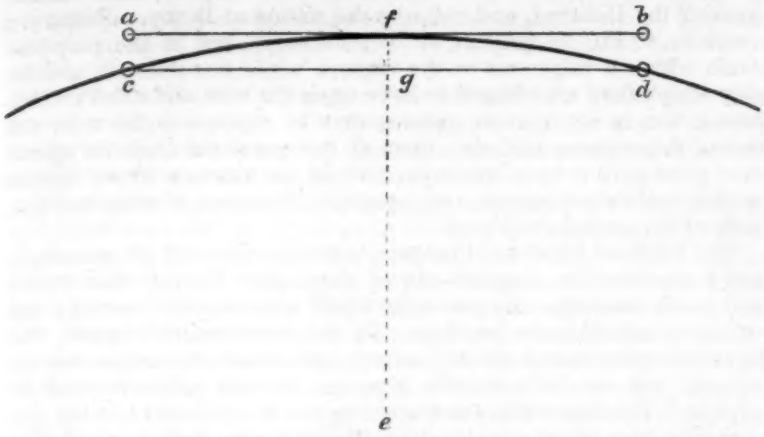
committed an error, in consequence of having laid the line intended for the first chord, *in the position of a tangent to the arc.* It appears from the field notes, that after having run off north from the town of New Castle a meridian line, as radius, the surveyors determined that the first chord of their circular arc should bear east and west, and, therefore, be *bisected* by the meridian radius; now it is perfectly evident that any chord of a circular arc, *bisected by a radius,* must cut that radius at a distance back from its extremity, equal to the versed sine corresponding to the given chord; therefore, in the case before us, the surveyors ought to have set back towards New Castle, from the extremity of the meridian radius of twelve miles, the proper length of the versed sine, or, nat. vers. sin. ½ ° × 12 miles radius = .0000381 × 3840 perches = .1463040 perches, or 2.414 feet; and from the correct point of concourse of the radius and chord determined thus, they should then have laid off from the meridian the courses and distances recorded in their field notes, viz: East 33½ perches, and West 33½ perches—in all 67 perches, the calculated length of the chord. This process would have correctly fixed the position of the chord, and, from its eastern and western extremities, the courses and distances of the field notes being run off, *an inscribed polygon* would have been correctly formed about "the end of the horse dike" at New Castle, as a centre.

But from the field notes it would appear that the right line designed for the first chord of sixty-seven perches, was laid off equally east and west, *from the extremity of the meridian radius;* it therefore occupies a false position, as regards a segment of a circle of twelve miles radius, described "*from the end of the horse dike*"—in fact, it is tangent to such an arc—but, nevertheless, in connexion with each other, the whole 120 chords run by the surveyors, do actually form sides of a polygon inscribed within a circle of twelve miles radius, *but relating to a centre, distant from the intended one, due north, the length of the versed sine, corresponding to the chord of one degree of the arc.* In consequence of the great length of the radius, this distance is fortunately of but little practical importance, being but 2.414 feet, as we have shown above; so that the real centre of the circular boundary line actually traced, is nearly two and a half feet distant from that which was established by the assembled magistrates.

The annexed diagram (on a scale distorted, of course,) will convey more clearly to the eye, the error we have attempted to point out.

a, b, = The east and west line, of sixty-seven perches, traced by the surveyors, in lieu of the proper chord, *c, d.*

e, f, = A portion of the meridian radius of twelve miles, run due north from "*the end of the horse dike.*"



f, *g*, = The versed sine corresponding to a chord subtending one degree of such an arc = 2.414 feet, which is of course the distance *due north*, which the centre of the circular segment was *in effect* removed by the error which appears to have been committed by the surveyors.

M.

Facts and Observations on Four and Six Wheel Engines. *

By JOHN HERAPATH, ESQ.

[CONTINUED FROM VOL. III, PAGE 391.]

Midland Counties Railway.

This line, as the public knows, unites Nottingham with Derby, and both with the London and Birmingham at Rugby. The length between Derby and Nottingham is 15½ miles; between Derby and Rugby 49⅓ miles; and between Nottingham and Rugby 47¾ miles. The total length of line worked is 57½ miles.

Here I have had an opportunity of seeing stone blocks, cross sleepers, and longitudinal bearings, mixed and intermixed in such a manner as to make a strong and decisive impression upon me of their relative advantages, of which I shall speak hereafter.

* The subject matter of these interesting papers—which we are engaged in re-publishing from the Railway Magazine—acquires renewed interest, from the occurrence of the late shocking accident upon the Paris and Versailles Railway, in France.

In this fearful catastrophe, it appears, from the newspaper accounts, that the passenger train was drawn by two engines, as in the case of the accident on the London and Brighton Railway, which we noticed at page 243 of the last volume; and, *as in that instance*, the auxiliary, or leading, engine, was *a four wheeled machine*, whilst the other ran on *six wheels*.

So also in the former, as in the latter case, *the four wheeled engine* was the first to fly the track; the second followed, and the destruction of carriages, and consequent loss of life, was terribly aggravated, by the fact that *at the same time* the train was also *impelled forward* from behind, by *a third engine*, attached for that purpose, which, partaking of the high velocity of the whole train, the moment the stoppage took place in front, drove forward, over the ruins of the rest, some of the rearward cars, which might otherwise have been saved with their passengers, and probably without injury. COM. PUB.

The great blot upon this line is a curve of only 11 chains radius, crossing the Derwent, and entering the station at Derby. Being at a terminus, it can be productive of no danger, but in the perpetual strain which it impresses on the engines while traversing it, and the play which they are obliged to have upon the rails and axles to compass it, are, in my opinion, great sources of expense in the wear and tear of the engines, and, also, upon all the rest of the road; for wherever great play is upon the rails, and in the axles, a strong sinuous motion is the consequence, and, naturally, an excess of wear and tear, both of the engines and road.

The Midland Counties' Company's stock consists of 29 passenger, and 6 merchandize, engines—28 of the former having four wheels and inside bearings, and one four wheel with outside bearings, and cylinders outside these bearings. Of the merchandize engines, four have four wheels and inside bearings, one outside bearings and six wheels, and one with outside bearings, outside cylinders, and six wheels. The four wheel passenger engines weigh from 11 to 12¼ tons each; the four wheel merchandize, 12 tons 6 cwt.; and the six wheel, nearly 15 tons. The proportion of weight on the leading and driving wheels of the lighter passenger engines, is as 3¼ to 5¼, and on the heavier, as 4 to 5¼; on the merchandize, as 4 to 5½. Four of these four wheel engines are coupled, and they are described as working pleasantly, safely, and economically. One of six wheel has flanches, "and is done without."

Of these 35 engines, 29 are now (December) ready to take a train.

But very few detentions of trains are represented to have taken place, and these not from derangement of machinery, but now and then cases have occurred of detentions from the bursting of boiler-tubes. There have been no failures from broken crank axles, and only in one case has an engine run off the line, and that was from the embankment having subsided a foot during the night, and a dense fog having in the morning prevented the engine driver of the first train from seeing the state of the road. This was with a four wheel uncoupled engine.

The first cost of engines of this company is from £1,250 to £1,400.

In answer to the question of what his experience tells him is the advantage of four or six wheel engines, one over the other, Mr. Kearsley replies, "both have advantages under different circumstances." I could have wished he had been more explicit, as from his experience with both kinds, his opinions merit attention. This gentleman says they have no top-heavy engines, and very little motion in any of them, except a little sinuous, owing to the play which they feel it necessary to give the leading wheels in the axles to combat the curves with. These sinuous motions, he observes, are nearly the same in all parts of the line, the Derby curve, I presume, excepted.

The average consumption of coke is from 25 lbs. to 35 lbs. per mile for passenger trains, and from 40 lbs. to 50 lbs. for merchandize trains. From some oversight, I suppose, he has not given me the gross loads taken with either train.

I believe, not one of their engines works expansively.

Mr. Kearsley is of opinion, that the nearer the cranks are to the principal axis of the engine, the steadier the engine works. The current locomotive expense of repairs, per mile, according to the last two months' returns, is 13½d.

On Wednesday and Thursday, Dec. 8th and 9th, I had opportunities of riding on seven of this company's engines—the *Vulture*, *Lynx*, *Sultan*, *Centaur*, *Bee*, *Hercules*, and *Unicorn;* all of which, except the *Hercules*, were four wheel engines.

The principal motions I observed in these engines were the sinuous, and these were obviously owing to the great play the engines had to prevent too great strain in turning the curve at Derby. The *Vulture* was an extremely lively engine, but too short in the springs, which made her rough to ride on. The *Lynx* was an easier engine to the rider. The *Sultan* was evidently a strong and powerful engine, but inferior in steadiness to the *Centaur*. The *Bee*, the engine to which Hall's smoke-consuming apparatus is applied, is a little four wheel engine, only five feet distance between the axles, with outside framing, and cylinders outside the framing. By some means she has a sad charac ter for endeavoring to turn her tail where her head ought to be, while running on the rails. However, in spite of this character, I accepted the offer of a ride upon her from Nottingham to Derby. There was a strong wind on our right, and we came along at a rapid rate for a little engine like the *Bee;* I should think, at some times, full 45 miles an hour. With such a wind and speed, and nothing but a slender rail to hold by, I had some difficulty, in the most exposed situation or the engine, to keep my place, and certainly had no small portion of my attention directed to the means of preventing myself from being blown off. However, from the attention I could spare, I did not perceive any of that dangerous tail-turning which I had heard of, nor any of that lateral wriggle I had noticed with outside cylinders, both on the Birmingham and Gloucester, and North Union, Railways. She had much sinuous motion, but appeared to me to have no other of any consequence, and so I told Mr. Kearsley when I arrived at Derby. Indeed, I thought I had here found an exception to the rule I had observed with all those engines having outside cylinders which I had rode on, namely, a lateral, or side, wriggle, or vibration, keeping time with the beats of the piston. In a letter, however, which I have since received from Mr. Kearsley, he mentions a subsequent trial with her, undertaken at my request, that considerably shakes my opinion. As he intends another trial, I forbear to say more of it at present.

The last engine, the *Bee*, and another, the *Hercules*, a six wheel engine, with outside framing and outside cylinders, and driving-wheels in the middle, were very kindly put on to special trains of goods by Mr. Kearsley, in consequence of the publication of my disappointment on the Grand Junction line with the *Œolus*, and such valuable opportunities they afforded, that I felt thankful to the parties of the Grand Junction for the disappointment.

Upon the *Hercules* I rode from Derby to Leicester, and though, probably, she was a good engine, both Mr. Kearsley and myself could not help noticing her sluggish heavy movements in comparison with

the nimble and agile motions of the previous four wheel engines. The contrast to me appeared very much like that of a heavy cart-horse to a blood-horse, and the same has been always my experience. Somehow or other, the four wheel engines trip off with their loads as if to take them was no effort, while the six wheel labour like animals over-encumbered with their own weight.

The *Hercules* had very sensible longitudinal motion when the velocity approached 25 or 30 miles an hour, and a considerable degree of lateral wriggle, which by leaning against the side rails and watching the eccentrics, Mr. Kearsley and myself observed kept time as nearly as we could determine, with the beats of the pistons.

While traveling upon this engine, I walked several times along the platform by her side, to her very front, stopping at various points to observe her motions. On the platform by her fire box, her side wriggle, and other motions, were most sensible; over the driving wheels they were much less so, and over the leading wheels, near where the cylinders were, they were to me imperceptible. The sinuous motion of her front framing, which on the platform appeared very great, when I stood at her head was very insignificant.

From Leicester I rode to Rugby, on the *Unicorn*, a very favorite engine, and deservedly so, of the Secretary, Mr. Bell. She was about the best engine of the company I had been on, most lively and active, but very noisy, from the constant blowing off of steam, which it seemed she generated without limit, as move at whatever rate we chose, she had still a superabundance of it. This engine was not without longitudinal motion, and, I thought, a slight disposition to roll.

The following table of these engines was furnished by Mr. Kearsley.

Particulars of Locomotive Engines inspected by Mr. Herapath.

Name of engine.	Diameter of cylinders.	Length of stroke.	Size of driving wheels.	Size of leading wheels.	Size of trailing wheels.	Total weight of engine.	Weight of fore part.	Weight of after part.	Wt. of leading wheels.	Weight of driving wheels.	Weight on leading wheels.	Weight on driving wheels.	Weight on trailing wheels.	Distance between centres of wheels.
	in.	in.	ft. in.	ft. in	ft. in.	ts. cw.	ts.cw	ts.cw	cw	ts.cw	ts.cw	ts.cw	ts.cw	ft. ins.
Vulture	12	18	5 6 4	0		11 1	4 6	6 15	17	1 9	3 9	5 6		5 6
Lynx	12	18	5 6 4	0		11 1	4 6	6 15	17	1 9	3 9	5 6		5 6
Sultan	13	18	5 6 4	0		12 4	4 17	7 7	18	1 12	3 19	5 15		6 0
Centaur	13	18	5 6 4	0		12 3	4 16	7 7	18	1 12	3 18	5 15		5 9
Bee	11	16	5 0 3	6		9 10	3 12	5 18	15	1 8	2 17	4 10		5 0
Hercules	13	18	5 6 3	9	3 9	14 18					3 18	5 10	1 10	11 0
Unicorn	12	18	5 6 4	0		11 1	4 6	6 15	17	1 9	3 9	5 6		5 6

For the following synopsis, extracted from a letter to me, of Dec. 14, I am indebted to the same gentleman.

"I send you a rough sketch of our line, with the distances, by which you will see we have three independent lines to work, viz:

from Derby to Rugby, 49¼ miles; from Derby to Nottingham, 15½ miles; and from Nottingham to the Junction, 7½ miles; which makes it a very difficult line to work, more especially as we have the London and Birmingham at one end, and North Midland and Derby and Birmingham, at the other; and we have to time our trains to suit all three.

"We run about 1,200 miles per day with trains and merchandize, and 500 miles on Sundays. The engines run commonly six weeks, and then stay in a week, except in cases where men have two engines appropriated to them, and, if both are in repair, they run every alternate week—every day in the week 100 miles, and take their turns on Sundays—this is between Derby and Rugby.

"Between Nottingham and Derby, two engines do the work; one runs 93 miles every day, and the other 60 miles every day. They change every week from the longer to the shorter distance.

"One engine in the day does the work between Nottingham and the Junction, running five trips there and back, or 75 miles per day. The driver there has two engines, and runs them alternate days, as the short length and frequent turning I think worse for an engine than running fifty or sixty miles in a length.

"Our goods engines between Derby and Rugby run three days and stay in one, then run three more days, and then in a day, and so on. Two engines came into the hospital yesterday, one having run 30,000 miles, and the other 25,000. Both have come in for new fire-boxes, the original iron boxes having failed, and I am about to substitute copper ones. Had it not been for the failure of the iron fire-boxes, I don't hesitate to say, that the machinery would have run as far again, with trifling repairs occasionally.

"Our bulk of expense in repairs has hitherto been in fire-boxes, nearly all the engines having been originally made with iron boxes, and the deceitfulness, if I may so term it, of that material, has added, I may say, at least 25 per cent. to our repairs. And I expect this will be proved, as I gradually substitute copper fire-boxes."

On this railway I had an opportunity of making some observations, which it may not be amiss here to record. In our travels from Nottingham to Leicester, on Wednesday morning, there having been previously a little rain, I was struck with observing the rails which lay on cross sleepers hold their wet and dampness much longer where the ballast came up to them and was within two or three inches of the top of the edge of the rail; and to part with it much earlier when the ground was hollowed out, and clear of them, to drain the surface. This was not universal, but it was so very general for nearly the whole distance, as obviously to make it, where it was not, the exception to the rule. What may have been the cause, unless it being a mild morning the ballast was much colder than the atmosphere, and communicating that cold to the iron in contact with it, prevented the quick evaporation of the wet, I am unable to explain. Mr. Kearsley, whose attention I called to the phenomenon, at first thought it might be owing to the air having a freer circulation round the rail where the ground was hollowed out, which caused a quicker

evaporation; but I was not satisfied with this explanation, and I do not think he was at last, inasmuch as there was little or no current of air, and the appearance was observed in nearly all situations.

The next day we had an opportunity of traveling over stone blocks, cross sleepers, and longitudinal bearings, the two latter in an instructive variety near Rugby. The unpleasant rigidity and harshness over the stone blocks were very sensible, but our attention was chiefly drawn to the comparison of cross sleepers with longitudinal bearings. I had previously mentioned some experience on the Hull and Selby Railway (which I shall hereafter detail,) of the greater draught over longitudinal bearings than over cross sleepers, with which he said his observations agreed, and now we endeavored to appreciate the comparative effects of the two as we traveled along. It appeared to me, and I believe to him, that the train ran much heavier on the longitudinals, which, like traveling over a heavy road, one easily feels; and between the sounds over the two there was no comparison. Over the cross-sleepers the train ran with comparative silence, but over the longitudinals there was a constant heavy murmur and noise. These phenomena of draft and noise happened not in one place, or change, only, but in every one—of which we had a much greater variety than I could have expected to meet with on any line. *To me the observations on this line are satisfactory in favor of cross-sleepers, as to lightness of draught and absence of noise.*

Birmingham and Gloucester Railway.

The American Engines.—I have recorded my experience of these engines, which is, that I was much pleased with their motions at velocities under 20 miles an hour. Since my return from the Great Western Railway, I have received a letter from Captain W. S. Moorsom, the engineer of the line, in which it appears that his experience of these engines, so long ago as the early part of 1840, as nearly as possible coincided with what I have said, page 1074 in the last volume of the *Railway Magazine.** The following is an extract from his certificate, given the 16th of January, 1840:

"The general result in my mind is a conviction that Mr. Norris's engines are admirable machines, particularly for full loads, say 100 tons, at a moderate speed, say 20 miles per hour; and for such occasions I should prefer them to any English engines with which I am acquainted. I have not yet had sufficient experience to judge of their durability, but I should infer from what I have seen, that in this respect, also, they will prove full as durable, and as economical, as any that we have in this country."

With their performances, as to motion under 20 miles an hour, I quite agree with Captain Moorsom. I had no opportunity of witnessing their power, but according to a private document which I have received, detailing some experiments and comparisons of them with one of our best English maker's engines, they fully merit all that the gallant Captain has said of them.

[TO BE CONTINUED.]

* Jour. Frank. Inst., vol. iii, 3rd series, page 385.

FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

On Earle's Process for Preserving Timber.

To the Committee on Publication.

GENTLEMEN:—In the Journal for last April, page 243, there is, appended to the communication of Mr. Trautwine, a note, which throws doubts on the efficacy and value of the process for the preservation of timber by the sulphates of iron and copper; and "these doubts are chiefly founded upon two facts.

"1. The wooden pavement in this city, in Sixth street, between Chesnut and George—a part of which was prepared by Earle's process prior to being laid—*now exhibits symptoms of decay.*

"2. The recent admirable experiments of M. Boucherie, upon the means of preserving timber, show that whilst corrosive sublimate and pyrolignite of iron effectually protected vegetable pulps from decay, the sulphates of copper and iron (employed by Dr. Earle) were so inert as to retard corruption in but a very trifling degree."

Such is the "note,"—which I have copied at length, that it and the remarks I desire to make on it, may accompany each other.

That there are in "the part prepared by Earle's process" (of the pavement in Sixth street,) as many as six or eight (or, not to diminish the number, say a dozen,) blocks which "*now exhibit symptoms of decay,*" is a fact not to be questioned; but those blocks are *single, insulated*, and in no instance, that I can discover, have had *any effect on the integrity of the adjoining blocks*—which, thus far at least, may be considered as of too sound constitution to be infected, or as *non-susceptible.* This is strong confirmation of the opinions expressed by Mr. Wallace and Mr. Thorn, in their (subjoined) certificate, that these imperfect blocks were *originally defective.* The opinion is still more powerfully strengthened by the condition of the remainder of the pavement in Sixth street, which is rotten and rotting from one end to the other—the decay having extended from the first block that gave way to the surrounding blocks—is already in extensive holes, constituting a large proportion of the pavement—the whole of which requires to be renewed. The same, or rather worse, is the condition of the square in Chesnut street, immediately contiguous, from Sixth to Fifth streets. Now, be it noted, that the whole of these pavements (in Sixth and Chesnut streets) were laid (in the summer of 1839) of precisely the *same wood*, and at the *same time.* Chesnut street required repairs in fifteen months after it was laid, has been often repaired since, and is now about to be renewed.

These are facts which lie exposed to the view and investigation of

any one interested in them, and are intimately—necessarily—connected with the *inference* to be derived from the admonitory "note," and importantly affecting it.

The quality of the wood, originally, was the *worst*. Of old hemlock, it had, part, if not the whole, been piled some time on the Market Street Railroad, and subsequently on the City Lot, where it was long exposed to all the influences of change of seasons and weather. I had, during a month or two, refused to accept it as the material for the first public essay of my process; but, finding that better was resolutely denied me, and confident in the *principle* of the process, I committed its reputation to this wood, hoping that some subsequent more propitious employment of it might soon occur. The result has been favorable beyond what it was reasonable to hope. That "part" of the pavement has, with the above individual exceptions, maintained its soundness, and already has outgone the anticipations justified by the quality of the wood. How much longer it will last, remains to be seen; but a comparison of it with the adjoining pavements, of the *same wood*, laid at the *same time*, is a demonstration of all I could desire of the process, and suggests the question—if such is its effect on this wood, how much greater may it not reasonably be expected to produce on wood of good quality? The certificate of Mr. Wallace and Mr. Thorn, will give confirmation to what I have stated.

"To correct an erroneous and injurious impression, entertained by many, relative to the wooden pavement in Sixth street, between Chesnut and George streets, we certify, that only a part of it was prepared according to Dr. Earle's process with the sulphates of iron and copper—the remainder being prepared with lime; that the former is still perfectly sound, except six or eight blocks, which, from examination, appear to have been originally defective, (the entire wood of that pavement is of hemlock that had been long kept and was very much injured in its quality;) and that the remainder of it, (prepared with lime,) up to the line where the former ceases, is so far decayed that at this time it almost requires renewal. The contrast between the two portions of that pavement is, in short, of the most obvious and conclusive kind. T. K. Wallace, *City Commissioner.*
Enoch Thorn, *City Carpenter.*
Philadelphia, April 25, 1842."

To M. Boucherie's "admirable experiments," I will oppose but one of the many facts that might be arrayed against them. It is, at least, as authentic, and by most minds, I believe, will be received as infinitely more conclusive. It is an extract of a letter from James Archbald, Esq., chief engineer of the Delaware and Hudson Canal and Railroad Company; dated "Carbondale, March 21, 1842."

"To your inquiries as to the long continued trial I have been making, of the rope prepared according to your process, with the sul-

phates of iron and copper, since your reference to it in your circular of March, 1841, I have the gratification to state, that at the request of John Wurts, Esq., the President of the Delaware and Hudson Canal and Railroad Company, that piece of rope (it was such as is known as two inch rope,) was subjected, about two years ago, to the most powerful influence of heat and moisture I could produce, by means of a hot-bed, or fungus-pit. Along side of it was placed another piece of similar rope, not so prepared, which, when I opened the pit to ascertain the result, was found entirely rotten. I then replaced it with a *second* sound piece, laying it, as before, by the side of yours; and in due time, was found thoroughly decayed—and in the same way, a *third* piece was completely destroyed. Indeed, so severe was the test, and the preservation of the rope, at the end of the experiment, was so satisfactory, that it induced me to recommend your process to the Company, whose mines and railroad are under my charge, and who are in the use of large amounts, both of timber and rope, for the inclined planes. I am glad to find they have adopted my advice, and contracted with you."

I have thus endeavored to separate and rescue the "part which was prepared by Earle's process," and the process along with it, from the condemnation, or doubt, likely to be cast on them by the "note," and I will not scruple to say, that a consideration of the quality of the wood—the present actual state of this "part,"—and of the extent and character of the decay it exhibits—with a comparison of it and the adjoining pavements of the *same wood*, laid at the *same time*, —furnish a conclusion altogether corroborative of the preservative power of the process, and satisfactory to my utmost wishes.

In less space, and with less particularity, I could not have given what I consider as their true and proper position and aspect to facts, of which the "note" itself indicates the importance.

I am, respectfully, gentlemen,
Your obedient servant,
EDWARD EARLE.

Philadelphia, June 8th, 1842.

Physical Science.

On the Chemical Statics of Organized Beings. Extract from the concluding Lecture, in L'Ecole de Médecine in Paris. By M. DUMAS.

Life, whose painful mysteries you are called upon to fathom, exhibits among its phenomena some which are manifestly connected with the forces that inanimate nature herself brings into action, others which emanate from a more elevated source, less within the reach of our boldest stretch of thought.

I. Plants, animals, man, contain matter. Whence comes it? What does it effect in their tissues and in the fluids which bathe them? What becomes of it when death breaks the bonds by which its different parts were so closely united.

These are the questions which we touched upon together, at first with hesitation, for the problem might be far above the powers of modern chemistry; we afterwards considered them with somewhat more confidence, as we felt from the silent and inward assent of our understandings that the path was sure, and that we could descry the goal gradually standing out, clear of all that obstructed our vision. If from these labors which you have witnessed, or, I should rather say, in which you have taken part; if from this scientific effort there have arisen some general views, some simple formulæ, it is my duty to become their historian; but allow me the pleasure of adding, that they belong to you, that they belong to our school, the intelligence of which has been exercised on this new ground. It is the ardor with which you have followed me in this career that has given me strength to pursue it; it is your interest which has sustained me; your curiosity which has awakened mine; your confidence which has made me see, and which proves to me at this moment that we are still in the path of truth.

These remarks will remind you of the wonder with which we found that, of the numerous elements of modern chemistry, organic nature borrows but a very small number; that from these vegetable or animal matters, now multiplied to infinity, general physiology borrows not more than from ten to twelve species; and that all the phenomena of life, so complicated in appearance, belong, essentially, to a general formulæ so simple, that, so to speak, in a few words the whole is stated, the whole summed up, the whole foreseen.

Have we not proved in fact, by a multitude of results, that animals constitute, in a chemical point of view, a real apparatus for combustion, by means of which, burnt carbon incessantly returns to the atmosphere under the form of carbonic acid; in which hydrogen burnt without ceasing, on its part continually engenders water; whence, in fine, free azote is incessantly exhaled by respiration, and azote in the state of oxide of ammonium, by the urine?

Thus from the animal kingdom, considered collectively, constantly escape carbonic acid, water in the state of vapor, azote, and oxide of ammonium, simple substances, and few in number, the formation of which is strictly connected with the history of the air itself. Have we not, on the other hand, proved that plants, in their normal life, decompose carbonic acid for the purpose of fixing its carbon and disengaging its oxygen; that they decompose water to combine with its hydrogen, and to disengage, also, its oxygen; that, in fine, they sometimes borrow azote directly from the air, and sometimes indirectly from the oxide of ammonium, or from nitric acid; thus working, in every case, in a manner the inverse of that which is peculiar to animals? If the animal kingdom constitutes an immense apparatus for combustion, the vegetable kingdom, in its turn, constitutes an immense apparatus for reduction, in which reduced carbonic acid yields

its carbon, reduced water its hydrogen, and in which, also, reduced oxide of ammonium and nitric acid yield their ammonium, or their azote.

If animals, then, continually produce carbonic acid, water, azote, oxide of ammonium; plants incessantly consume oxide of ammonium, azote, water, carbonic acid. What the one class of beings gives to the air, the others take back from it; so that to take these facts at the loftiest point of view of terrestrial physics, we must say that, as to their truly organic elements, plants and animals spring from air, are nothing but condensed air; and that, in order to form a just and true idea of the constitution of the atmosphere at the epochs which preceded the birth of the first organized beings on the surface of the globe, there must be placed to the account of the air, by calculation, that carbonic acid and azote whose elements have been appropriated by plants and animals. Thus plants and animals come from the air, and thus to it they return; they are real dependences of the atmosphere.

Plants, then, incessantly take from the air what is given to it by animals; that is to say, carbon, hydrogen, and azote, or rather, carbonic acid, water, and ammonia.

It now remains to be stated, how in their turn, animals acquire those elements which they restore to the atmosphere; and we cannot see without admiring the sublime simplicity of all these laws of nature, that animals always borrow these elements from plants themselves.

We have, indeed, ascertained, from the most satisfactory results, that animals do not create true organic matters, but that they destroy them; that plants, on the contrary, habitually create these same matters, and that they destroy but few of them, and that in order to effectuate particular and determinate conditions.

Thus it is in the vegetable kingdom that the great laboratory of organic life resides; there it is that the vegetable and animal matters are formed, and they are there produced at the cost of the air.

From vegetables these matters pass ready-formed into the herbiverous animals, which destroy a portion of them, and accumulate the remainder in their tissues.

From herbiverous animals, they pass ready-formed into the carniverous animals, who destroy or retain some of them, according to their wants.

Lastly, during the life of these animals, or after their death, these organic matters, as they are destroyed, return to the atmosphere whence they proceeded.

Thus closes this mysterious circle of organic life at the surface of the globe. The air contains, or engenders, oxidized products, as carbonic acid, water, nitric acid, oxide of ammonium. Plants, constituting true reducing apparatus, possess themselves of their radicals, carbon, hydrogen, azote, ammonium. With these radicals they form all the organic, or organizable, matters, which they yield to animals. These, forming, in their turn, true apparatus for combustion, re-produce carbonic acid, water, oxide of ammonium, and nitric acid, which

return to the air, to produce anew, and through endless ages, the same phenomena.

And if we add to this picture, already, from its simplicity and its grandeur, so striking, the indisputable function of the solar light, which alone has the power of putting in motion this immense apparatus, this apparatus never yet imitated, constituted of the vegetable kingdom, and in which is accomplished the reduction of the oxidized products of air, we shall be struck with the import of these words of Lavoisier:

"Organization, sensation, spontaneous movement, life, exist only at the surface of the earth, and in places exposed to the light. It would seem that the fable of the torch of Prometheus was the expression of a philosophic truth which had not escaped the ancients. Without light, nature was without life, was dead and inanimate: by the gift of light, a beneficent God spread upon the surface of the earth organization, feeling, and thought."

These words are as true as they are beautiful. If feeling and thought, if the noblest faculties of the soul and of the intellect, have need, for their manifestation, of a material covering, to plants is assigned the framing of its web with the elements which they borrow from the air, and under the influence of the light which the sun, its inexhaustible source, pours in unceasing floods upon the surface of the globe.

And as if, in these great phenomena, all must be connected with causes which appear the most distant from them, we must, moreover, remark how the oxide of ammonium, the nitric acid, from which plants borrow a part of their azote, are themselves almost always derived from the action of the great electric sparks which flash forth in stormy clouds, and which (furrowing the air through a vast extent,) produce there the nitrate of ammonia which analysis detects in it.

Thus, from the craters of those volcanoes whose convulsions so often agitate the crust of the globe, continually escapes carbonic acid, the principal nutriment of plants; from the atmosphere flashing with lightnings, and from the midst of the tempest itself, there descends upon the earth the other and no less indispensable nutriment of plants, that whence they derive almost all their azote, the nitrate of ammonia contained in storm-showers. Might not this be called, as it were, an idea of that chaos of which the Bible speaks, of those times of disorder and of tumult of the elements, which preceded the appearance of organized beings upon the earth?

But scarcely are the carbonic acid and the nitrate of ammonia produced, than a form more calm, although not of inferior energy, comes to put them in action; it is light. Through her influence, the carbonic acid yields its carbon, the water its hydrogen, and the nitrate of ammonia its azote. These elements unite, organized matters form, and the earth puts on its rich carpet of verdure.

It is, then, by continually absorbing a real force, the light and the heat emanating from the sun, that plants perform their functions, and that they produce, this immense quantity of organized, or organic, matter—pasture destined for the consumption of the animal kingdom

And if we add, that animals on their part produce heat and force in consuming what the vegetable kingdom * has produced, and has slowly accumulated, does it not seem that the ultimate end of all these phenomena, their most general formula, reveals itself to our sight?

The atmosphere appears to us as containing the primary substances of all organization, volcanoes, and storms, as the laboratories in which were first produced the carbonic acid and the nitrate of ammonia which life required for its manifestation, or its multiplication.

In aid of these comes light, and developes the vegetable kingdom, immense producer of organic matter; plants absorb the chemical force which they derive from the sun to decompose carbonic acid, water, and nitrate of ammonia; as if plants realized a reducing apparatus superior to all those with which we are acquainted, for none of these would decompose carbonic acid in the cold.

Next come animals, consumers of matter and producers of heat and force, true apparatus for combustion. It is in them, undoubtedly, that organized matter puts on its highest expression. But it is not without suffering from it that it becomes the instrument of sensation and of thought; under this influence, organized matter undergoes combustion; and in reproducing the heat and the electricity, which produce our strength, and which are the measure of its power, these organized, or organic matters, become annihilated, in order to return to the atmosphere whence they came. Thus the atmosphere constitutes the mysterious link which binds the vegetable to the animal kingdom.

Vegetables, then, absorb heat, and accumulate matter which they have the power to organize.

Animals, through whom this organized matter only passes, burn or consume it, in order to produce in its aid the heat and the different powers which their movements turn to account.

Suffer me, therefore, if, borrowing from modern sciences an image of sufficient magnitude to bear comparison with these great phenomena, we should liken the existing vegetation (truly a storehouse in which animal life is fed,) to that other storehouse of carbon constituted of the ancient deposites of pit-coal, and which, burnt by the genius of Papin and Watt, also produces carbonic acid, water, heat, motion; one might almost say life and intelligence.

In our view, therefore, the vegetable kingdom will constitute an immense *depot* of combustible matter, destined to be consumed by the animal kingdom, and in which the latter finds the source of the heat, and of the locomotive powers of which it avails itself.

Thus we observe a common tie between the two kingdoms, the atmosphere; four elements in plants and in animals—carbon, hydrogen, azote, and oxygen; a very small number of forms under which vegetables accumulate them, and under which animals consume them; some very simple laws, which their connexion simplifies still more: such would be the picture of the most elevated state of organic chemistry which would result from our conferences of the present year.

You, like myself, have felt, that before separating we have need of

* "*Le règne animal*" in the original; but this is obviously an error.—Edit. *Phil Mag.*

collecting our thoughts, of fixing with precision all the facts, of bringing together and summing up the opinions which explain and develope these great principles; lastly, that it was useful, as regarded your future studies, to give you in writing, and in a clearer form, the expression of these views, which were partly brought into existence under the stimulus of your presence, and consequently reduced into form with the hesitation which so often accompany the first enunciation of our thoughts.

[TO BE CONTINUED.]

Description of a new Universal Photometer. By DR. CHARLES SCHAFHAEUTL, *of Munich, Assoc. Inst. C. E.*

The inadequacy of the photometric instruments invented by Pictet, Rumford, and others, is universally acknowledged. The bromide of silver, as used by Sir John Herschell, although extremely sensitive, is only slightly affected by artificial light.

These circumstances induced the author to complete the present instrument, which he contemplated about twelve years since.

The intensity of the undulations of gaseous fluids, as well as that of the air, is proportional to the amplitude of the oscillations, or, more properly, to the square of the amplitude.

A wave of light striking the retina must create a similar vibratory motion in the nerves of the retina, because the velocity of the molecular movement of the nerves depends upon the force with which they have been struck by the original wave, and if this velocity could be measured, it would show at the same time the intensity of light.

It is scarcely possible to obtain a direct accurate measurement of this velocity, but if the time during which the vibratory motion of the nerves ceases be ascertained, the velocity of the vibrating molecules, and, therefore, the intensity of light, may be determined, because the duration of an impression on the retina is dependent on the resistance which the molecules of the nerves oppose to every force striking them; but as this resistance of the nerves increases as the square of the velocity, four times the momentum, or intensity, is necessary to double the time of duration—or, in other words, the intensity of the pencil of rays is as the square of the time of the duration of that impression made on the nerves of the retina.

The new photometer consists of a brass bar fixed vertically in a stand, carrying at its upper end a small tube in two parts, which may be lengthened from five to ten inches, if requisite. This eye tube has at each end a sliding plate pierced with holes of corresponding diameters. From the bottom of the bar a projecting arm sustains the lower end of a strip of rolled steel, eighteen inches long, $\frac{5}{16}$ths inch broad, and $\frac{1}{32}$nd inch thick; this has at the upper end a thin plate, pierced with a small hole, corresponding with the holes in the sliders, and standing one-eighth of an inch from one of them: upon the main bar is a prism with a slit in it, through which the strip of steel passes; this prism can be moved up or down, by a rack and pinion, so as to lengthen or shorten the vibrations of the strip.

The method of using the instrument is to adjust the two holes at the opposite ends of the horizontal eye tube, so that they perfectly correspond, and do not permit any rays of light to enter, unless the plate at the extremity of the spring be pushed aside. The light to be compared is then placed at a certain given distance behind the plate, so that by bringing the axis of the hole which is pierced in it into the axis of the tube, a small pencil of light may enter the pupil of the eye. The prism is then placed at 100 of the scale on the side of the brass bar, and the steel strip caused to vibrate gently. A luminous disk immediately appears, accompanied by scintillations, which are caused by the impressions on the retina being interrupted by dark intervals: the prism is then gradually raised, until the length of the vibrations of the strip being diminished, and the velocity increased, the luminous disk appears perfectly steady and clear. The length of the vibrating portion of the strip is then read off by the verniers marked on the brass rod, and compared with the whole length of the spring, measured from 100, which is considered as unity. The number of the vibrations to be computed from the found length of the spring, are inversely to the numbers of vibrations of the whole length, as the squares of their relative lengths. Hence are constructed the formulæ for calculation, which are given at length in the communication.

A fresh luminous impression is made on the retina as often as the circular aperture in the screen, on the top of the spring, cuts the axis of the tube. If the duration of the small vibration of the nerves of the retina is shorter than the time of a vibration of the spring, a dark interval appears between the two luminous impressions. In this case the vibration of the spring is shortened until the next impression returns just as the first ceases, and therefore the dark interval disappears; then by measuring the length of the shortened spring, the number of vibrations can be computed, and from them the intensity of the light.—*Trans. of the Inst. of Civ. Eng.* Jour. of Arts & Sci. Nov.

Propagation of Sound.

M. Colladon has forwarded to the French Academy of Sciences an account of some experiments he had been making on the Lake of Geneva, relative to the propagation of sound; he had tried over again an experiment made by Mr. Bonnycastle, on the coast of the United States, in 1838, and recommended by M. Arago, in order to find whether sound could be reflected back from the bottom of a lake, or piece of water, and by measuring the time of its passage, to calculate the depth of the water. Mr. Bonnycastle had not been able to hear the sound of a bell under water at a greater distance than 8000 or 10,000 feet, but M. Colladon had succeeded in propagating a sound of this kind to the distance of 13,500 metres, or 42,640 feet; he had also found that when a blow was struck on a bell partly out of water and partly under water, two sounds were heard, one coming by the air, and the other by the water. At a little distance the latter was the less strong of the two, but at a great distance the contrary was the

case, and the sound transmitted by the water was the more intense; it could even be heard when that by the air was totally imperceptible; he was of opinion that, under favorable circumstances, sound might be transmitted through the sea for a distance of 100,000 metres, or upwards of sixty English miles. Mining Jour.

Franklin Institute.

COMMITTEE ON SCIENCE AND THE ARTS.

Harvey Leach's Suspension Railway Ferry and Drawbridge.

The Committee on Science and the Arts, constituted by the Franklin Institute of the State of Pennsylvania, for the promotion of the Mechanic Arts, to whom was referred for examination a Suspension Railway Ferry and Drawbridge, invented by Mr. Harvey Leach, of Philadelphia, Pennsylvania, REPORT:—

That they have examined the outline drawings, and the model, submitted to the Institute by the projector, and find that his devices have two leading features, which make it convenient to treat them separately, as follows:

I.—*Of the Suspension Railway Ferry.*

Here the design is, to carry a railway across navigable waters, at such an altitude as to permit the free passage beneath it of ships under sail; to suspend from a large truck, running upon this railway, a fenced platform, of sufficient dimensions, and at a proper level, to receive passengers and freight from piers on both shores. This pendant deck, or platform, when required, is to travel from side to side—by the aid of suitable machinery, acting upon the truck carriage—and is thus designed to provide a means of transport over the water, at intervals longer or shorter, according to circumstances.

The two lines of rails are to be supported, each upon the inner side of the lower chord of a lattice truss of iron, very similar to that of Smart's well known bridge, patented in England, 4th of July, 1822,* and recommended by the patentee to be applied to pendant bridges, precisely as is here done. The antecedent patent, of Ithiel Town, January 28th, 1820, also covers lattice trusses of iron, as well as those of wood, so well known in this country.

Each of the trusses which carry the rails is proposed to be strengthened and sustained by chains, or cables, of iron, suspended in the usual manner from the summits of piers, which rise above the trusses for that purpose, and which are to be formed of pillars, kept separate as high as the rails, to allow a free transit of the pendant deck, in both directions.

In the lithographic engraving before us, several cables are represented as attached to one truss; they are arranged in different curves, one above the other, as in the wire bridge constructed by Mr. Ellet, at Fairmount; and in the particular plan referred to, it is not designed to secure the chains, or cables, to either bank, but simply to fasten

* London Journal (Newton's) of Science and the Arts, vol. v, page 233.

them to, or connect them with, the truss, at equal distances on both sides of the piers—the trusses projecting (for that purpose) towards the land, from each shore pier, a distance equal to about half the adjacent span. If the model in the hall of the Institute were sawn asunder, transversely, in the middle, the parts of the truss would remain balanced by the cables over each land pier as a fulcrum, and would in that case very closely resemble the trusses of the lattice suspension drawbridges used upon the railway between Philadelphia and Wilmington; and the same principle—that of balancing the bridge upon suspending bars, extending equal distances from the supporting piers—was long since used by Wernwag, the celebrated carpenter, in constructing a bridge across the Neshaminy Creek, in this State.

The *main details* of the project before us, cannot, therefore, be regarded as novel, and its *general features* appear to us to interfere with "Fisher's Suspension Railway," patented in England, 2nd of April, 1825,* which had in view the same object, viz:

"To construct railways by throwing chains from any two points, as over a river or ravine, or across a swampy ground; and to suspend from the catanarian curve of the chain, by means of perpendicular rods, a straight rail, upon the lower side ledges of which the wheels of carriages are to run."

These carriages in Fisher's patent (of which the form is not described,) were to be pendant below the suspension railway, and travel from shore to shore, like the hanging deck, or platform, of the project before us.

In view of these considerations, the Committee, whilst they cannot recommend Mr. Leach's project on account of its *novelty*, must (for obvious reasons) leave the question of its *utility* to be decided by its cost, and the particular circumstances of those localities, where such devices may be considered applicable, merely remarking, in conclusion, that the capacity of existing means of transportation across navigable waters, where common bridges are inadmissible, is such, as to leave but little to be desired, in point of speed and certainty—except where masses of ice present an obstruction to the progress of vessels propelled by steam.

II.—*Of the Suspension Railway Drawbridge.*

This is a modification of the other project, and is designed to be applied in chief to railways arriving at the banks of navigable waters, at an elevation so low as to preclude their passage without obstructing the navigation—such, for example, as the railway approaches to the Susquehanna River, at Havre de Grace. In these cases, Mr. Leach proposes to bring out the railway, from both shores, upon suspension bridges, to two very elevated piers upon the margin of the channel, some three or four hundred feet apart; to erect centrally between them, a third pier, of the same altitude—thus forming two channel spans—and to suspend from these three piers, by flat catenarian curves, a lattice truss, high enough to clear the shipping, and having movable, upon a railway thereon, a pendant platform, of the full

* London Journal (Newton's) of Science and the Arts, vol. xi, page 98.

length of one span; this movable span is to be wholly or partially withdrawn, into the other, whenever vessels are to pass. This is an application of Fisher's patent to a new use, and upon it must rest Mr. Leach's claim to *novelty* in this branch of his scheme.

From the summits of the tall marginal piers above mentioned, the cables, or chains, are to sweep down towards both shores in a catenarian curve, of which the land piers of suspension will be comparatively low, and the vertex, consequently, much nearer to the banks, than to the piers of the drawbridge.

From this description, it will be at once perceived that practical difficulties must flow from such a plan, owing to the inequality of the angles of inclination of the tangents of the catenaries, at the points of suspension, as well as to the unequal loads imposed upon the channel spans by the operations of the drawbridge; and it is a question not yet affirmatively settled in the minds of the Committee, whether suspension bridges are as suitable as others to carry the trains usually drawn on railways by locomotive steam power?—for it is certain that the attempts hitherto made to apply such bridges upon railways, have not succeeded, and it is probable that to render them successful (at least in such long spans as those of the project before us,) it would be necessary to increase the weight of the chains so prodigiously, as to render the expense too serious to be encountered in ordinary cases.

Under these circumstances, without entering further into detail, the Committee are not prepared to recommend Mr. Leach's drawbridge project for general use in navigable waters, though they incline to the opinion that, in a modified form, it may possibly be applicable in some cases, if its expense does not forbid its adoption.

By order of the Committee,

March 10th, 1842. WILLIAM HAMILTON, Actuary.

Grimes' Smut Mill.

The Committee on Science and the Arts, constituted by the Franklin Institute of the State of Pennsylvania, for the promotion of the Mechanic Arts, to whom was referred for examination a Smut Mill, invented by Mr. William C. Grimes, of York, Pennsylvania, REPORT:

That they have examined the machine, and obtained such information relative to its practical efficiency, as was within their reach. The operation which it is designed to perform is one of peculiar difficulty, and has hitherto been executed very imperfectly. The smut balls, as they are termed by the miller, are so nearly of the same size and weight as the grains of wheat, that no means have ever been devised for removing them without first breaking or crushing, and afterwards riddling or winnowing, or both.

When the smut is thus broken, the finer portions of it have a tendency to adhere to the wheat, especially by insinuating into the cleft of the grain, and cannot then be removed. Mr. Grimes has contrived this machine with a view to remove the difficulty, by subjecting the smutted wheat, simultaneously, to the action of revolving beaters, which shall break the smut, and a strong current of air, which shall

blow away the fragments before they can attach themselves to the grain.

The beating is effected by thin cast iron webs, fixed longitudinally on the exterior of a vertical cylinder, which revolves within a cylindrical cast iron case, the inner surface of the case being fluted longitudinally, to prevent the grain from being carried directly around with the revolving cylinder, and cause it to rebound repeatedly when it has been thrown against the case by the centrifugal motion communicated by the beaters.

The interior cylinder extends a few inches above the top of the surrounding case, and the webs which form the beaters are here expanded radially, so as to form vanes for the production of a strong upward current of air in the annular space between the cylinders.

The grain to be cleaned enters this space near the upper end; as it descends by gravity, the smut is broken by the beaters, on the well known principle of the increased resistance of a fluid medium in proportion as the mass of the penetrating body is diminished, the powdered smut is blown out at the top, while the larger grains of wheat descend and escape through an opening below. Beside the main features now described, there are several minor devices, which are ingeniously adapted to lessen certain practical difficulties, particularly those to prevent the blowing out of the wheat before it has acquired sufficient downward velocity to resist the blast, and the dangerous tendency to overheating the upper journal, which deserve commendation; but as they do not constitute any part of the general principle, it is not thought necessary to complicate the report with a particular description of them.

From a mere inspection of these several contrivances, the Committee would be inclined to form a favorable opinion of their adaptation to their intended object; but as the cleaning of smutted wheat is an operation which cannot be reduced to any certain rules of mechanics, and can, therefore, only be judged of by experiment on a practical scale, inquiry has been made of parties using the machine, and it has been examined in actual use. The result of this inquiry and examination has fully confirmed the good opinion of the Committee, and they feel warranted to commend the machine to the notice of millers, as capable not only of making good white flour from wheat so badly smutted as to be generally considered unmerchantable, but which will also improve the general quality of his flour by the removal of cheat and of the down, or furze, which covers one end of the grain, and of most other accidental foreign matters which tend to injure the quality of the flour.

In conclusion, the Committee take pleasure in recommending this invention to the Managers of the Institute for an award of the Scott's Legacy premium.

By order of the Committee,

March 10*th*, 1842. WILLIAM HAMILTON, Actuary.

Mechanics' Register.

LIST OF AMERICAN PATENTS WHICH ISSUED IN MAY, 1841.

With Remarks and Exemplifications by the Editor.

1. For an improvement in *Railroad Carriages;* Albert Bridges and Charles Davenport, Cambridgeport, Middlesex county, Massachusetts, May 4.

This improvement is in the manner of suspending the body of the car to the frame, so as to give it a free oscillating, or pendulous, motion, which may be checked by side springs, to avoid the unpleasant and injurious jarring motion, occasioned by the striking of the flanches of the wheels against the rails.

Claim.—"We claim supporting the carriage, or body of the same, upon, or connecting it to, the wheel frame, by means of the rough braces, or pendulous bars, or links, either suspended or not, at pleasure, to springs on the wheel frame, and arranged according to the modes represented (all of which modes permit a lateral motion of the running machinery, independent of the body of the carriage,) in combination with the side springs, opposed to said lateral motion, and which are disposed and operate substantially, in the various ways described."

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2. For an improvement in the *Press for Cheese, &c.;* Damon A. Church, Friendship, Alleghany county, New York, May 4.

The follower of this press is forced down by means of a weight, the cord from which is attached to, and actuates, a double ratchet wheel, which has its shaft hollow, and is received on to a shaft carrying two double scroll wheels, one on each end. The cords are then conducted in such a manner over pulleys, as to effect the pressure by means of the weight; but the arrangement cannot be readily described in words alone, and we therefore pass to the claim.

Claim.—"What I claim, and desire to secure by letters patent, is the manner in which I have arranged and combined the respective parts thereof, so as to accomplish the desired end—that is to say, the manner in which I have combined the double ratchet wheel with the shaft—the (double scroll) wheels and the cords winding around said shaft, and passing over the pulleys in the movable pieces; by which combination and arrangement, the weight which is attached and suspended, in the manner described, produces a progressive and continuous pressure upon the cheese, or other article to be pressed. It will be manifest that considerable difference may be made in constructing this machine without departing from the general principle, or mode of action, upon which it is dependent; I do not intend, therefore, to limit myself in this particular, but to vary this machine as I may think proper, while I produce the same effect, by means substantially the same."

3. For improvements in the *Horse Power* for driving Machinery; J. Francis Moore, Falmouth, Stafford county, Virginia, May 4.

In this machine there is to be a main horizontal wheel, which is to be drawn round by the horse, and this has truck rollers attached to the under side of its rim, which run on circular rails on a suitable platform. This wheel, by means of cogs on its inner periphery, drives a small wheel, to the axis of which is affixed another large wheel, which runs on truck rollers on a second platform, and, by means of cogs on its inner periphery, drives a pinion, or small cog wheel, from the shaft of which motion may be communicated to a thrashing machine, &c.

Claim.—"What I claim is the manner in which I have combined and arranged the respective parts thereof—that is to say, I claim the combination of the two wheels with the two platforms and with each other, in such manner as that said wheels shall be supported on their respective platforms by trucks, or friction wheels, and revolve thereon without the aid of axles, or gudgeons. I claim, also, the particular arrangement and combination of the four wheels, in the manner set forth—the two larger wheels having cogs, or teeth, on the interior of their rims, and mashing into, or engaging with, the two smaller, by an arrangement of the respective parts, substantially the same with that herein described."

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4. For an improvement in the *Harvesting Machine*, for cutting, thrashing, and winnowing Grain; Damon A. Church, Friendship, Alleghany county, New York, May 4.

On the forward part of this machine there is a set of V shaped cutters, with points that separate the heads of the grain from the straw; above these cutters there is a gathering wheel, with strips that reach from end to end, to catch the heads of the grain, as the gathering wheel revolves, and force them against the V cutters, which separate them from the stocks. The heads of grain are delivered from the cutters on to an endless apron, which extends along behind the cutters until it arrives at a point where it meets two endless aprons, between which the grain is conducted up to a thrashing machine, of the usual construction; from the thrashing cylinder the grain and straw are discharged on to an endless apron of netting, with meshes sufficiently small to prevent the passing through them of the thrashed heads, but allowing the grain to fall upon another endless apron, which carries it back, until it falls down in rear of a fan wheel, by which the chaff and dirt are blown out, whilst the grain descends into a box. The cutters are each hung upon a joint pin at the heel, and are borne up against the gathering wheel by a spring.

The claim is to the "manner of constructing the knives, or cutters, so as to hang each of them upon a rod, or joint pin, whilst they are each sustained by a spring, as described." Also, to the combination of the apron that receives the grain from the gathering wheel, with those that conduct it to the thrashing cylinder; and, finally, to the

endless apron of net work that receives the grain, &c. from the thrashing cylinder, with the one that conducts the grain to the fan.

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5. For an improvement in *Mill Spindles and Vertical Shafts;* Jacob Staub, Georgetown, District of Columbia, May 4.

The patentee says:—"The object which I design to obtain by my improvement, is to have less friction, and to give better opportunity to repair the end of the spindle."

At the bottom of the step, or ink, there is a movable *plug*, which runs up into a hole made in the bottom of the spindle, or shaft, the upper part of the said hole being occupied by another movable plug, which has a small hole through its whole length, to receive and conduct oil from the box, in which the whole works—the oil escaping through a lateral hole in the lower end of the shaft, or spindle. As the whole weight of the shaft rests on these two removable plugs, the wear will be confined to them, and when worn, they may be removed and replaced by others, simply by taking out the spindle.

Claim.—"What I claim as my invention, and improvement, and which I desire to secure by letters patent, is the arrangement of the lower removable plug in the step, or bed, in combination with the upper removable plug, in the spindle, or shaft, and provided with a hole to admit oil from the box, for the purpose, and in the manner, specified."

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6. For an improvement in the manner of constructing *Paddle Wheels* for Steamboats; P. G. Gardiner, New York City, May 4.

"On each of my paddle wheels I use a double row, or series, or a greater number, of buckets; which buckets are placed so as to form an angle with the axis of the wheel; and I deem it best to place them so as to stand at an angle of forty-five degrees, or nearly so, with said axis, or shaft; but a variation of from four to five degrees from this angle may be made without materially interfering with the action of the wheel. In constructing my wheel with a double row, or series, of buckets, there must be three sets, or series, of arms, the middle being twice as numerous as the two outer series, the buckets of each outer series meeting in the middle. I do not claim the mere placing of the buckets in such a manner as to form an angle with the axis, or shaft, of the wheel—this having been done, but with other views, and under arrangements differing from those adopted by me;—but what I do claim as constituting my invention, and desire to secure by letters patent, is the placing of a double series of buckets so to form an angle of forty-five degrees, more or less, with the axis of the wheel; said buckets having each of their inner ends attached to a distinct arm, thus allowing a free or open space between each bucket, in each series of buckets, as set forth; said buckets being convoluted in consequence of their being attached to radial arms, in the manner described."

7. For improvements on his *Cap Spinner;* also applicable to others; Charles Danforth, Paterson, Passaic county, New Jersey, May 4.

The lifters in this cap spinner, as in that originally patented by Mr. Danforth, are worked by arms radiating from the main driving shaft; on each end of the said driving shaft there is a grooved pulley, from which a band runs to two inclined grooved pulleys on each end of the lifter, and passes along in front, and returns along the back, of the lifter—it being supported, as it passes, by guide pulleys, ranged along the front and back edges thereof. On this belt the bobbins rest, and by it they are driven. The inclination of the inclined groove pulleys must be such as to receive the band from, and return it to, the grooved pulleys on the ends of the main shaft, in a proper direction, to prevent them from running off. The spindles are oiled along that part of their length over which the bobbin passes, by means of a tube attached to the lifting rail, which dips into an oil cup at the bottom of the dead spindle, and spreads the oil as it ascends with the lifting rail.

Claim.—"The principle of this invention, for which I claim a patent, consists of the combination of the main shaft, and pulleys thereon, with the inclined pulleys on the lifters, and the pulleys and radius rods, carrying, sustaining, and guiding, a band, or cord, so as to drive the bobbins resting on the band, or cord, at the required rate and force, the bobbins being constructed and kept supplied with oil, as aforesaid, substantially as above. I also claim the method of supporting, guiding, and working, said endless band, or cord, by means of the inclined carrying pulleys on the lifters, and the grooved end pulleys in connexion with the grooved pulleys on the main shaft, thereby giving motion to the bobbins, by causing an endless band, or cord, to pass under them, with their weight bearing on said band, or cord, substantially as aforesaid, by whatever mechanical means the regulating action, effected by the radius rods, may be produced. I also claim the reciprocating motion given to the grooved end pulleys by means of radius rods, studs, and brackets, essentially as herein described. I also claim the method of applying oil to the spindles and bobbins, in spinning machinery, substantially as above described. And I further claim as my invention, the use of inclined pulleys upon lifters, carrying and guiding a band, or cord, upon which bobbins are made to rest and to be turned, substantially as aforesaid, by whatever mechanical means the said band, or cord, may be guided to and from said inclined pulleys, as the said lifters rise and fall in the operation of any spinning machine to which said inclined pulleys, bands, or cords, may be applied. I also claim the combination of pulleys, whether inclined or not, upon the lifters, with a band, or cord, and bobbins, resting upon them, and carried by said band substantially as aforesaid. I also claim the combination of pulleys, inclined or not, upon spindle rails, carrying, guiding, and moving bobbins, by the weight of these, on a band, or cord, as aforesaid."

9. For a machine for *Separating Gold from its Ores;* Thomas Seay, Columbia, Georgia, May 4.

This machine is very similar to others which are used for the same purpose, differing from them in some particulars which have been deemed sufficient to become the foundation of a patent; the following is the claim:

"What I claim as my invention, and desire to secure by letters patent, is, constructing the rocking trough, or amalgamator, with an undulating surface on its bottom plank, in combination with the top plank, provided with pins, and fitting into said trough, which will produce the desired effect.

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10. For an improvement in *Bee Hives;* Constant Webb, Willingford, New Haven county, Connecticut, May 4.

The claim on which this patent was granted, gives the character of the improvement with sufficient distinctness; we deem it unnecessary, therefore, to offer any other description of it.

Claim.—"I do not claim as my improvement the movable bottom merely, nor the suspension of the hive for protection from the moth, as both are common; but I do claim as my invention and improvement, and as new and useful, the peculiar form of the construction of the hive, by making the front board shorter than the sides and back, so that the bottom is made to slide in, and rest on cleats attached to the inside of the sides, and can be wholly drawn out for the convenience of hiving bees, and when hived, can be replaced, and the hive closed without shaking it or disturbing the bees, till the hive and its contents are safely removed to their proper station; all which I claim, in combination with the mode of suspending the hive so as to make the bottom an inclined plane, while the top and body of the hive project forward, to protect the bees from storms, &c., all as described."

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11. For improvements in the *Fanning Mill,* for cleaning Wheat from smut, garlic, &c.; David Philips and Asa Jackson, Franklin Mills, Mercer county, Virginia, May 4.

This machine is constructed for the purpose of separating, by a current of air, the pure wheat from garlic and other impurities, the specific gravity of which may be less than that of wheat.

The grain passes in a thin stratum down an inclined plane, to a vertical flue, or aperture, where it is met by a strong current of air, from a fan, which deflects the various materials, according to their specific gravity. Below the flue there are three vertical plates, the first being immediately under its forward part, and the other two at appropriate distances apart—thus forming two flooms—the upper edges of the last two being armed with sliding plates, or regulators, which are bent forward towards the current of air. The pure wheat, which is said to be the heaviest, will fall between the first and second vertical plates, the next heaviest between the second and third, and all the light impurities will be discharged at the back part of the machine.

Claim.—"What we claim as new, and of our own invention, and which we wish to secure by letters patent, is the construction of the winnowing machine, or fan, with a vertical flue, or aperture, as set forth; in combination with the inclined plane, and the vertical plates, the two first being governed by regulators."

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12. For an improvement in the *Seed Planter;* Joseph Gibbons, Adrian, Michigan, May 4.

A patent was granted to Mr. Gibbons, for a seed planter, on the 25th of August, 1840, and is noticed in this Journal, vol. ii, 3rd series, page 258. The improvement referred to in the above title, is added to this patent. The patentee says:

"My improvement is intended to be applied to the said machine (referred to above) when it is constructed for the purpose of planting a single row of seed. With this intention, I make perforations in several rows around a planting cylinder, which holes are to vary in size and number according to the nature of the seed to be planted. Above this cylinder I place a hopper for containing the seed, which hopper is so formed and arranged as to be capable of being slid along from end to end of the planting cylinder, so that the opening on its lower side, through which the seed is to pass into the cavities, or excavations, in the planting cylinder, may be made to stand directly over either of the rows.

"Having thus fully described the nature of my improvement in my planting machine, what I claim therein, and desire to secure by letters patent, is the manner in which I have formed and combined the planting cylinder and hopper, as above set forth—that is to say, a cylinder having several rows of cavities, or excavations, around its periphery, with a hopper placed above it, and made capable of sliding along it, substantially in the manner, and for the purpose, set forth. I also claim the manner of placing the guide wheel in front, and on one side of the machine, so as to allow of its being readily tilted, to cause the share to make a furrow of greater or less depth."

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13. For an improvement in the manner of *arranging the Keys of a Piano Forte;* John Dwight and Daniel B. Newhall, Boston, Massachusetts, May 6.

The above named improvement is for "curving the front ends of the keys, and arranging them on a curved line." The patentees say: "The nature and character of our improvements are to facilitate the execution of music on the piano forte and other keyed instruments, particularly when the bed of keys is long, consisting of six, seven, or more octaves, by which a performer is enabled to reach the extreme keys more conveniently."

Claim.—"What we claim as our joint invention and improvement, is the concave curvature of the bed of keys in front, as described."

14. For an improvement in *Door Locks;* John P. Sherwood, Sandyhill, Washington county, New York, May 6.

This alleged improvement in door locks consists in the mode of moving the bolts by means of a weight instead of by a spring. The weight, which works the latch bolt, and which is called a *car* by the patentee, slides at an angle of about forty-five degrees with the bottom edge of the lock, on a stud pin, and on the spindle of the knob, it being provided with two slots for that purpose; this weight is connected with the rear end of the bolt, by a connecting link of a peculiar form.

Claim.—"I do not claim the employment of a weight to work the latch bolt, as a substitute for a spring—that having been previously done; but what I do claim as my invention, and desire to secure by letters patent, is the method of working the bolt by means of the sliding inclined car, as described, and also the mode of connecting the latch bolt with the sliding car, by means of the link, for the purpose, and in the manner, described."

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15. For improvements in the machine for *Removing Obstructions, or Bars, from Harbors, Rivers, &c.;* James R. Putnam, New Orleans, Louisiana, May 11.

The sand, mud, or other earthy obstructions, at the bottom of rivers, &c., is first to be loosened, by drawing through it a series of ploughs, attached to a frame, which is provided at its back with a number of cutters, to subdivide the furrows made by the ploughs. After the obstructing earth, &c., has been loosened as above stated, a second machine is dragged over it, in order to remove it; this machine consists of two inclined scrapers attached to a frame, one behind the other, and in front of each scraper there is a plate, the upper edge of which is jointed to the frame. When this machine is passed over the earth, the jointed, or swiveled, plates, are closed up, leaving a narrow space between their edges and the scrapers, through which the earth, sand, &c., is forced, and is thereby lodged on the plates, and when the whole is drawn into deep water, the weight of the contents opens the jointed plates, and thus the earth is discharged. These two machines are suspended by chains to two boats, the forward boat being used to drag, and the back one to regulate the depth to which the machines shall sink.

Claim.—"What I claim as my invention, and which I desire to secure by letters patent, is the combination of the scrapers with the swivel plates, for the purpose, and in the manner, described. Also, the arrangement of ploughs, in combination with the cutters, for the purpose, and in the manner, described."

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16. For an improvement in the *Washing Machine;* George Waterman, Johnston, Providence county, Rhode Island, May 11.

This machine consists in part of two dashers, that are worked up and down in a trough, or box, by two levers, and by tappets on a

shaft, which act on one end of the said levers, the other end passing through a loop on the handle of each dasher. At the bottom of the box in which the dashers, or pestles, work, there is a rocking false bottom, which is called a vibrating bottom, and is pierced with small holes, for the passage of the water that is to be squeezed out of the clothes, which are placed on the said false bottom, and upon which the dashers fall.

The claim is to the "vibrating bottom, in combination with the dashers," as specified.

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17. For improvements in *Hot Air Furnaces and Fire Grates;* William H. Whiteley, Charleston, Suffolk county, Massachusetts, May 11.

The claim in this instance refers throughout to the drawings, and is, therefore, omitted. It is confined to two improvements, the first of which consists in an arrangement of flues for heating the air that is to be conveyed to the apartments to be heated, and the second to an arrangement of the grate, in combination with a catch, which answers the double purpose of holding the grate in its place, and of scraping off the cinders in cleaning out the fire chamber.

The fire chamber is surrounded by two concentric cylinders, except where the door is placed for the admission of coals, &c., with a space between each—the inner cylinder being pierced with holes. The fire chamber is covered by a plate, in which are inserted tubes for the passage of the draught, and of the air to be heated. The cold air is admitted into the outer space around the fire chamber, from which it passes, through the holes in the inner concentric cylinder, to the chamber surrounding the fire cylinder, thence into some of the flues above the fire chamber, which are surrounded by the draught flues, that carry off the gaseous products of combustion into the chimneys; and the heated air is conducted by pipes, governed by dampers, into the apartments to be warmed.

The grate is made with side pieces, or cheeks, of a wedge-like form, that slide on inclined bed pieces, and the catch, which holds the grate in its place, is hinged to the furnace, directly in front of the grate, and catches in a mortise made for that purpose. When the grate is drawn out, the catch drags over the top of the bars, and clears off the cinders.

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18. For an improved method of constructing *Cocks for Hydrants;* Ebenezer Hubball, Baltimore, Maryland, May 11.

This improvement consists in a method of constructing the piston of the valve and the screw pipe through which it slides, and by which it is secured to the cock and valve seat, so that the screw cap may be unscrewed, and the valve and piston removed from above, without removing the hydrant; all which is to be effected by making the piston square, or polygonal, and fitting it into a hole of the same form, in the screw cap, instead of making it round, as heretofore.

The claim is confined to the above described improvement, and the

patentee says:—"Although I make use of the terms square and polygonal, I would conceive my patent infringed by the use of any shape of piston and opening in the screw, whereby the same power to unscrew and screw in again, without disturbing the hydrant, would be obtained."

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19. For an improvement in the *Smut Machine*, for cleaning Grain; Jacob Dimuth, Benjamin Banman, and Levi Beck; the two former of Lancaster township, and the latter of Lampeter, Lancaster county, Pennsylvania, May 11.

To a suitable shaft are attached four metal disks, placed at given distances apart, and four sets of bars, passing through holes in, and attached to them, constitute four open beaters, extending, radially, from the shaft to the periphery. The four spaces, into which the diameter is divided, between the two inner disks, are occupied by four similar beaters, the bars of which are of smaller size than those first named. The spaces between the two inner, and the two outer, disks, are occupied by solid beaters, consisting of plates, some of which are parallel with the axle, and others placed obliquely. This beating apparatus revolves within a drum, or cylinder, the periphery of which is formed of triangular bars, and which revolves in a direction the reverse of that of the beater—the whole being placed horizontally.

The claim is to the beater, constructed in the manner stated, "in combination with the cylinder, constructed with angular straps, as described, the beater and cylinder revolving horizontally, and in opposite directions."

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20. For an improvement in the *Wind Chest for blowing the fires of Forges and Furnaces;* Charles Foster, Rochester, Monroe county, New York, May 11.

The patentee says:—"I disclaim the original invention of the bellows box, and what I claim as my invention, and desire to secure by letters patent, is the method of constructing the top of the box by forming it with two oblong apertures, or tubes, inclined towards each other, for the purpose of concentrating the draught of air, and increasing its power of action on the fire."

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21. For an improvement in *Paddles for propelling Boats;* Samuel Swett, Jr., Chelsea, Suffolk county, Massachusetts, May 11.

"The paddles, or buckets, by which the propelling is to be effected, are attached to frames which stand horizontally, and which are made to vibrate back and forth, and are raised up and down by means of cranks. The paddles, or buckets attached to the vibrating frames, would, were they immovably affixed thereto, dip into, and rise from, the water vertically; but instead of so attaching the paddles to vibrating frames, I hang them upon pivots, which admit of their having a vibrating motion communicated to them, independently of that which they receive with the frame. The intention of this is to cause them

to enter, and to leave, the water in a direction varying a few degrees from a vertical line; and this they are made to do by means of eccentrics upon the ends of the cranks which carry the vibrating frames, there being shackles, or connecting rods, from said eccentrics, leading to, and connected with, one or more of the paddles. I intend, in general, to use two vibrating frames, each carrying three paddles, on either side of the boat, or other vessel.

"What I claim as constituting my invention, and desire to secure by letters patent, is the giving to the paddles, or buckets, in the particular kind of apparatus herein described for propelling boats, or other vessels, an independent vibratory motion within the vibrating frames to which they are attached, for the purpose of causing them to enter, and to leave the water in a line inclined from the perpendicular, as described.

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22. For an improvement in the *Machine for Packing Tobacco;* Thomas Samson, Richmond, Virginia, May 11.

This apparatus consists of four staves of cast iron, or other metal, cast hollow, their outer surfaces being segments of a circle, and their inner surfaces straight. The edges of these staves, where they come together, are united. These staves are placed one against each side of the tobacco box, and by means of hoops and wedges, they and the box, and the tobacco within, will be drawn together.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the constructing and using of four staves, or billets, of cast iron, or other metal—said staves being cast hollow, and having their contiguous edges formed with a mitre joint, or in such a manner as will admit of their being drawn together by means of bands, or hoops, by which they and the contained box are to be embraced when in use."

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23. For an improvement in the *Argand Lamp, for burning Spirits of Turpentine, &c.;* John S. Tough, Baltimore, Maryland, May 11.

"The reservoir and burner are made in the usual manner of Argand's lamp, except the outer cylinder of the latter, which is made about an inch higher than the inner cylinder, and slightly flaring outward. The principal improvements are in the construction and arrangement of a sliding cylinder, which fits the inner cylinder of the Argand's burner, having its upper end enlarged, so as to fit the space between the inner and outer cylinders of the burner being flared outward, so as to press the wick against the inside of the outer cylinder, which is also made slightly flaring outward, as before noticed, provided with a funnel-shaped button, or inverted conical regulator, which slides up and down, for concentrating the air around the flame, and increasing its intensity, and a glass globe, with a circular rim inside the same, made in the form of a hollow frustum of a cone rising inward from the lower rim of the globe, for contracting the space and impinging the column of air around the flame; the slope of said flanch extending downward from the flame, outside the wick, whilst the

slope of the button extends also down from the flame, but inside the circle of the wick.

"What I claim as my invention, and which I desire to secure by letters patent, is the combination of the conical rim at the bottom of the globe, with the inverted cone regulator, or button, and adjustable cylinder, adapted to, and combined with, the wick case, as set forth."

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24. For an improvement in the *Self Sharpening Plough;* Isaac Snider, Carrollton, Pennsylvania, May 11, 1841; which improvement was added to a patent granted to him on the 29th of July, 1837, noticed in this Journal, vol. xxi, 2nd series, page 273.

The claim in this instance refers throughout to the drawings, and is therefore omitted. The first item claimed is to the making a groove in that part of the mould-board which is hollowed out to receive the share, there being a projection on the share to fit into the said groove. The second item is for making the cutter with two hooks, one to hook on to the neck of the mould-board, and the other to hook below the point, to "support the same; by means of which arrangement, the cutter serves as a clamp to hold the mould-board and point together." The third item is for making the cutter in two separate pieces, with a depression to admit a movable blade, fastened in by two rivets, "which enables the farmer to change the edge from wrought iron to steel." And the last item is for making the share in two pieces, with a tenon in front, to receive a movable blade, for the same purpose for which the cutter is made in two.

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25. For an improved apparatus, called a *Walking Aid*, for the relief of persons who are unable to walk, from weakness of the knee or ankle-joints; Stephen P. W. Douglass, Williamson, Wayne county, New York, May 15.

This apparatus resembles, in its general features, others which have long since been in use for the same purpose, and which are well known to surgeons. The apparatus consists of side plates running along the side of the thigh and leg, jointed together at the knee, and attached to the hip, the knee, and the foot, by appropriate straps, &c. There is a spring which bears on the thigh and leg plate, and which is connected with the knee joint by means of a screw, said screw serving to increase the tension of the spring, which thus constantly tends to straighten the knee. The knee joint of the apparatus is connected with the limb by means of a "patella cap," which embraces the knee above and below, one side being hooked to the screw, where it forms the connexion with the apparatus, and the other to a strap that passes under the limb, but not in contact with it, and is attached to the screw, where it passes through the spring—thus avoiding the binding of the limb all around, which would tend to arrest the circulation of the blood. The attachment to the foot is by means of straps that pass under the foot, around the heel, and over the in-

step, and then to a bow-piece attached to the lower end of the side plate. There are various modifications described in the mode of applying the spring, by substituting, for that above named, a helical or a volute spring; and also a modification of the mode of attaching the apparatus to the foot, which would require drawings to make them clear.

This apparatus, as described by the patentee, has been the result of long and painful experiment on his part, and has been gradually brought to its present improved form, for the relief of his own sufferings. Without it he would not be able to walk, not even by the aid of the best instruments for the purpose previously constructed; but by means of his own improvements, he is enabled to move about with considerable facility.

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26. For a machine for *Making Posts and Fences from Clay;* Mercy Wright, Tullytown, Bucks county, Pennsylvania, May 15.

At each end of a suitable frame, provided with two sets of rails, or tracks, for the passing of a car, there is a revolving platform, with rails corresponding with those on the frame. A car, the upper part of which contains, or is formed into, a mould, runs upon the rails; and by means of cogged wheels which take into a rack, attached to the under side of said car, it is drawn under a roller which compresses the clay into the mould, and then under a scraper which takes off the surplus clay. When the car reaches the platform at one end, the mould is removed, the platform turned, and the car passed on towards the opposite platform, where the mould is again filled with clay, and the whole operation repeated.

Claim.—"What I claim therein, and desire to secure by letters patent, is the manner in which I have constructed, combined, and arranged the machine for the purpose of moulding and pressing brick clay, so as to form the parts of fences, as set forth; that is to say, I claim the manner in which I have combined the two revolving platforms, the railways, the car with its moulds, and the roller and scraper, substantially as set forth, so that said parts shall co-operate in effecting the object of their construction."

This machine, it appears, is the contrivance of a female, and we wish that its utility was equal to the skill with which its parts are arranged; but we cannot believe that posts made of brick clay, having mortises in them, and that rails of the same material, fitting into said mortises, will ever be used to surround and divide a plantation. The material will be too fragile, however well it may be baked, and would be liable to break down under the man who should attempt to climb it.

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27. For an improvement in the machine for *Extracting Stumps of Trees*, and for removing buildings; Luke F. Cavanaugh, Newfield, Tomkins county, New York, May 15.

"The nature of my invention consists in arranging a strong screw

in a perpendicular position in a suitable frame, to the head of which screw is attached a sweep, or lever, moved by animal, or other, power, and by which the screw is turned in a movable nut, on which an inclined movable bar rests, and to which the chain, made fast to the stump, is attached, so that as said nut rises on the screw, the end of the bar also rises, and the stump is drawn from the ground; said frame being placed on a carriage of four wheels, for the purpose of moving it from place to place."

"What I claim as my invention, and desire to secure by letters patent, is the bed piece and movable bar, in combination with the screw nut and carriage, as described."

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28. For an improvement in the *Straw Cutter;* John B. King, Athens, McMinn county, Tennessee, May 15.

The knife which cuts the straw, in this machine, is hung at each end to a crank; the shaft of each crank having a fly wheel, and a band wheel, with a band passing from one to the other, for the purpose of causing the two cranks to revolve at the same time.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the method of hanging the knife on two pivots that are placed in the two cranks, each having a separate fly wheel attached to it, which balance wheels receive a simultaneous motion, produced by means of two drums that are coupled together by a band."

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29. For an improvement in the process for *Removing Wool and Hair from the Skins of Animals;* Francis and Hanson Robinson, Wilmington, Delaware, May 15.

"We do not claim the use of any particular apparatus for carrying the same into effect, but employ such instruments and means as are now known and used for other purposes; but what we do claim, and desire to secure by letters patent, is the process of loosening the wool, or hair, from skins, or hides, by the direct application of steam thereto; said skins, or hides, being suspended in any suitable room, or apartment, into which steam can be admitted."

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30. For an improvement in the construction of *Pumps;* William M. Wheeler, Liberty, Clay county, Missouri, May 15.

The lower part of the barrel of this pump is of much greater diameter than the upper, and the piston is made to fit into both; that part fitting the small barrel is made hollow, and is provided with a valve at its upper end, where it is connected with the piston rod. When the piston is drawn up it acts as a lifting pump, the water flowing in to fill up the vacuum in the lower, or larger, part of the barrel, and this, on the descent of the piston, is forced up through the hollow piston into the small barrel; and as the lower barrel is of greater diameter than the upper, the water received in it during the descent of the pis-

ton, will more than fill the small barrel, and hence the water will be forced out at the top.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is constructing the barrel with an enlargement below, and having a plunger with an aperture in its centre, adapted to said enlargement, in combination with a hollow piston, or stem, attached to said plunger, and passing up through a portion of the smaller diameter of the pump barrel, having a valve at its upper end to close the aperture in it, through which the water mounts on the descent of the plunger, by which arrangement the apparatus is constituted a lifting, as well as a forcing, pump; in other words, what I claim is constructing the apparatus in such a manner that on every descent of the piston rod a vacuum, or space containing no water, is formed in the pump above the plunger, the object of which is to admit a sufficient quantity of water on every ascent of the piston rod, to keep a constant stream flowing at the discharging pipe, as described."

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31. For an improvement in the manner of making the *Joints of Clothes Horses;* Harvey Luther, Providence, Rhode Island, May 15.

The above named patent is for a method of making the hinges by which the frames of clothes horses, called by the patentee clothes stands, are united. The side pieces of each frame are made round, and the two that are to be hinged together have a groove around them, near the top and bottom, the groove being deep enough to receive a cord, or chain, which passes around one of them, is then crossed, passes around the other, and is fastened on the inside.

The patentee says—"I am aware that clothes stands, &c., have been hinged by means of cords, or straps, attached to square rods, so as to allow them to fold in either direction, and I do not, therefore, claim this as my invention, but what I do claim, and desire to secure by letters patent, is the peculiar manner in which I make the hinges, that is to say, I claim the making the rods constituting the frames which come together, with grooves in them, in combination with the method of uniting them by means of cords, or chains, in the grooves, as described."

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32. For improvements in *Horizontal Wing Piano Fortes;* Frederick C. Reichenback, Philadelphia, Pennsylvania, May 19.

The claim is to the "manner of constructing and arranging the wrest pin block, and the wrest pins, so that the latter shall pass entirely through the former, and receive the wires at their lower projecting ends;" and also to the "manner of constructing, arranging and combining wrought iron braces with the wrest plank and straining board, said braces passing over the wrest pin block, bearing against its back edge, and resting at their rear ends on the straining pin plate."

33. For an improvement in the *Recumbent, or Library, Chair;* Henry P. Kennedy, Philadelphia, Pennsylvania, May 19.

The improvement above named is in that kind of recumbent chairs in which the seat slides in the frame, and is clearly indicated in the following claim, viz:—"What I claim as my invention, and desire to secure by letters patent, is the combination of a spiral spring, or springs, with the rails and sliding seat of a recumbent chair, which will allow the seat to be forced forward, and the back to assume a reclining posture, and which will restore the seat and back to their ordinary position when the force is removed, as described."

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34. For improvements in the machine for *Moulding and Pressing Bricks;* Waldren Beach and Ephraim Lukens, Baltimore, Maryland, May 22.

In this machine the moulds are arranged in a horizontal wheel, and pass under a hopper, from which they receive the tempered clay; they then pass under a pressing roller, which is in connexion with the hopper, its sides embracing that portion of the roller which presses the clay. As the moulds advance they pass under a knife, which is hung to an arbor and is pressed upon by a spring, which knife cuts off the surplus clay, whilst it yields, in the event of meeting with a stone. A projection from the under surface of the pistons that form the bottom of the moulds, is acted upon by an inclined plane that forces the bricks out of the moulds, and then as the wheel continues to rotate, the bricks are, by means of a guide, delivered on to a belt, by which they are carried off to any desired place of delivery. After the moulds have been emptied, they pass under a rotary sieve to be sanded, and thence to the hopper. The filling of the moulds is effected by two pallets, called by the patentee cams, each of which is hung to a shaft that passes across the lower part of the hopper, and through its side, and is there connected with a weighted lever, which lever projects from the shaft in the same direction with the pallet. The axes of these pallets being above the surface of the mould wheel, the weighted levers will cause their extreme ends to bear on the surface of the wheel, and as the moulds pass under, the clay is forced into them by the inclined surface of the pallets. The axles of the pallets are provided on one side with a knife to cut off the clay to the proper width.

Claim.—"What we claim as our invention and improvement, and which we desire to secure by letters patent, is—First. The rotating horizontal wheel, in combination with the duster. Second—The box, or casing, round the bottom of the pressing roller, in combination with the horizontal wheel and hopper, in the manner set forth. Third—The combination of the horizontal wheel with the cams in the bottom of the hopper, the said cams having attached to them a knife inside the hopper, and a weight, or lever, outside of the same. And fourth—We claim also the manner of combining the pressing roller with the hopper, in the manner described, viz: by arranging

the said roller on the outside of the hopper, and connecting it with the same, by means of the casing surrounding said roller, as set forth."

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35. For an improvement in the *Churn;* Enos Mitchell, Pittston, Kennebec county, Maine, May 22.

This churn has double dashers, which are to be operated upon by two bent levers.

The claim is to the "method of combining the two dashers of the churn by means of the two bent levers, and the connecting rod, operated by the arm on the rock shaft."

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36. For improvements in the manner of operating the *Cotton Gin;* David Phillips, Georgetown, Mercer county, Pennsylvania, May 22.

The frame of this cotton gin is placed on wheels, and is called by the patentee a car body. The wheels run on a circular rail, the body being supported by a beam projecting from a vertical shaft, that has its bearings in the centre of the platform, to which the circular rail is attached, and in a frame above. The forward wheel is to guide the car, or gin, body, and the hinder is to operate the gin, by means of a large belt wheel attached to, and turning with it, which is connected with the roller, or cylinder, of the gin by a belt.

Claim.—"I claim, as my invention, the car body described, so constructed as to receive the seed and clean cotton, in combination with the supporting and guide wheels, arranged and operating substantially as described."

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37. For *Maintaining Power* to drive machinery; Stephen P. W. Douglass, Williamson, Wayne county, New York, May 22.

The object of this machine is to receive and regulate any irregular, or intermitting, power obtained from any source, and to give it out regularly, as may be required. Two endless chains, placed side by side, are each passed around two wheels, placed one above the other. A pinion, attached to a suitable sliding frame, is situated between the two chains, with its teeth taking into their links; and to this sliding frame is suspended a heavy weight. The irregular, or intermitting, force is applied to the shaft of one of the wheels, acting on either of the chains, which, by its operation on the pinion, winds up the weight, provided the other chain be held permanent, but as this weight tends to turn this chain, one of its wheels is connected with, and actuates, any machine requiring to be moved with regularity. If the power applied be equal to that given out, the pinion, with its weight, will remain in the same position, and will simply transmit the power which it receives; but if the former exceeds the latter, the pinion and weight will be raised, and when the former becomes less, then they will sink. In this way it will be seen that the winding up of the weight does not prevent it from giving out its full force, as it is always suspended to the chain which gives out the power.

Claim.—"What I claim as new, and desire to secure by letters patent, is the manner in which the two endless chains are arranged, and connected, and are combined with the respective wheels, or pinions, and with the weight to be raised, and with the machinery to be propelled, so as to obtain a regular propelling force, either from an intermitting motive power, or from a continuous irregular power, as herein described."

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38. For an improvement in *Files for Filing Newspapers, &c.*, called the "Movable Binder;" Isaac Detterer, Philadelphia, Pennsylvania, May 22.

This movable binder consists of two sides of a book cover, and to the back edge of one of which two screws are attached, that pass through two holes in the other cover; the papers, pamphlets, &c., to be filed, or held between the covers, are placed between them, and by means of two handles, provided with screw nuts, the whole is held together. The handles are split, and spring apart, like crayon holders, and have a slide to close them, their inner ends being provided with threads to fit the screws.

Claim.—"I claim, as my invention, the combination of the book cover, the screws, and the movable handles, for the purpose of binding and unbinding, at pleasure, letters, newspapers, music, &c.

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39. For an instrument for taking measure of the body, preparatory to cutting coats, called the *Tailors' Measure;* Lyman B. and Ellery Miller, Middletown, Orange county, New York, May 29.

The patentees say, "We are aware that there are a number of measuring instruments consisting of elastic strips of metal, and which are attached to the person whose measure is to be taken; we do not, therefore, make any claim to the individual parts of our instrument. But we do claim the combining of four strips of metal, which are to stand horizontally when the instrument is in use, with four others which are to stand vertically, the whole of which slips are made adjustable by means of sliding sockets, and have one measuring tape attached to them."

The left hand vertical strip is placed in the middle of the back, and its upper end is provided with a strap that passes around the neck; the second at the back of the shoulder, the third in front of the shoulder, and the fourth in the middle of the breast. The lower horizontal strip passes around the waist, the second under the arms, (the end of each of these being provided with a strap to pass entirely around the body,) the third extends from the middle of the back to the shoulder, to measure the extreme width of the back, and the fourth passes over the shoulder and unites the upper ends of the second and third vertical straps. A strap is attached at the junction of the second horizontal and the third vertical strip.

40. For an improvement in the *Wind-Mill;* William Zimmerman, Stephenson, Rock Island county, Illinois, May 29.

This patent was obtained for a mode of regulating the inclination of the sails, as the wind increases or decreases, by means of "the centrifugal governor." The sails of the wind-mill are all connected with a disk, at one end of a sliding rod, which rod passes through the centre of the shaft of the sail wheel, it being made hollow for that purpose; the end of the sliding rod opposite to the disk is provided with a rack, said rack being acted upon by a pinion that receives its motion from the slide of the governor. The increased velocity of the wind wheel will throw out the balls of the governor, which, by their connexion with the sails by means of the sliding rod and disk, increases their inclination, and thus lessens the action of the wind upon them, and consequently retards the motion of the mill.

Claim.—"What I claim therein as of my invention, and desire to secure by letters patent, is the weathering of the sails by the action of the sliding rod, or piston, and the disk, operated upon by the governor substantially in the manner set forth, whether said disk be made to operate upon the sails by means of the rods, by racks and pinions, or by any other device which is the same in principle, and producing a like effect, by means substantially the same."

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41. For an improvement in the *Counter Twist Speeder;* Jesse Whitehead, Manchester, Chesterfield county, Virginia, May 29.

"The nature of my invention and improvement consists in the application of the revolving block, or driving drum, directly to the metallic guide which is placed in front of the twisting belts, or bands, for twisting the roping, which is delivered as it passes through the guide directly against the block, and near the centre thereof, horizontally, and conveyed from thence between the guide and block to the bobbin placed above the block, and in contact therewith—the said guide being grooved, or channeled, along its concave side to admit the roping, for the purpose of keeping it in its compressed state, as it leaves the twisting belts."

"What I claim as my invention, and desire to secure by letters patent, is the before described mode of delivering the twisted roving in the compressed state in which it leaves the twisting bands at a uniform and regular tension, by means of the aforesaid combination and arrangement of guide, block, and bobbin. I also claim the construction of the metallic curved and channeled guide, as described."

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42. For improvements in the machine for *Riving and Shaving Shingles;* William S. George, Baltimore, Maryland, May 29.

"The timber from which the shingles are to be made by my machine, is to be cut of the proper length, and rived out so as to constitute square bolts, of such size as shall adapt them to the width of the shingles to be formed from them. These bolts are to be placed in a frame prepared to receive them; a piece of the proper thickness for a

shingle is then rived off by means of a reciprocating knife, which piece falls upon a table below the riving knife, whence it is driven forward between two dressing knives, which, as it passes between them, are made to approach towards each other in such manner as to give a regular taper to the shingle, the edges being jointed at the same time, by jointing irons duly fixed for that purpose."

The knife that rives the shingle is attached to a sliding frame with two tables, one of them forward of the knife to gauge the thickness of the shingle to be rived, and the other level with the top surface of the knife, to support the block. The shingle is then forced between two sets of knives, the one set being permanent for dressing the edges, and the other set for shaving the surfaces, which are so arranged as to approach each other as the shingle passes through, to taper it.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the manner in which I have combined and arranged the frame for holding the bolts with the vibrating frame, its panels, and riving knife, so as to rive shingles from the bolt, as described. I also claim the within described manner of constructing and combining the dressing and jointing apparatus, the dressing knives being made to approach other, and the jointing frames being affixed and operating substantially as above described."

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43. For a mode of *Treeing Boots;* Elias Hall, Jr., Spencer, Worcester county, Massachusetts, May 29.

The boot tree, after the boot is placed upon it, is put upon a bench properly adapted to it, and the rub-stick is connected with a lever, or sweep, by a swivel, or hinge joint, so as to allow it to take any required position, whilst the lever, or sweep, to which it is attached, can only move up and down, and vibrate to and fro. The upper end of this lever is connected with a standard by a rod attached to said standard, and sliding in a slot, the end of the rod being enlarged and fitting in a hole bored in the end of said lever, such hole being of greater diameter than the width of the slot, so that the lever, with the rub-stick, may slide up and down, and be retained by the enlargement on the end of the rod.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the combination of the rub-stick with the sweep in the manner described, said sweep having a swivel joint and a hinge joint, to allow the rub-stick to adapt itself to the inequalities of the boot. Also the method of combining the sweep and rub-stick with the standard by means of the rod, having a boll on its end, adapted to a groove, or slot, on the upper end of the sweep, as set forth."

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44. For an improvement in the *Press for Compressing Hay, Cotton, &c.;* Charles W. Hawkes, Brunswick, Maine, May 29.

The follower of this press is operated by racks and pinions in the usual manner; but the racks, there being two of them, are attached to uprights that work on the outside of the box, and are connected

with the follower by a cross beam which extends from one upright to the other.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the manner in which the racks are combined with the follower of the press, by being attached to the uprights outside of the box, and connected with each other, and with the follower of the press, by the cross beam."

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45. For an improvement in the *Pump;* Sidney S. Hogle, Lansingburgh, Rensselaer county, New York, May 29.

In the barrel of this pump there are two pistons, the rod of one passing through the other, so that as one piston descends the other rises, and vice versa, by which a constant stream of water, which passes through a valve in the upper piston when it descends, is kept up. The two pistons are operated by means of two spiral fillets, or grooves, called by the patentee cams, or eccentric grooves, made in a vertical drum, or enlarged part of a shaft, which act upon rollers on the ends of the piston rods.

Claim.—"What I claim as my invention is the combination of the suction and lifting pistons so as to produce an alternate action, as described, by means of the shaft constructed with cams, or eccentric grooves, and the rollers attached to the head of each piston rod, as described."

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46. For an improvement in the *Tobacco Press;* Thomas G. Hardesty, Tracey's Landing, Ann Arundel county, Maryland, May 29.

"In my improved tobacco press, the hogshead in which the tobacco is to be pressed has both heads removed, and it is placed horizontally upon the frame of the press, resting upon two long, longitudinal pieces of timber near the ground, prepared to receive it; and two false hogsheads, or receiving cylinders, the same in diameter, or nearly so, with the hogshead, are placed upon the same longitudinal pieces in a line with it, said hogshead being situated between them. The hogshead and the two false hogsheads are to be filled with tobacco by hand, and may be made to contain the whole quantity that is required to be packed in the hogshead. When thus prepared, pressure is to be made at each end of the apparatus, by means of two screws, which force up two followers, said followers entering and passing through the false hogsheads, and forcing all the tobacco which had been placed in them for that purpose, into the hogshead situated between them. The false hogsheads are so constructed as to admit of their being removed from the press without its being necessary to retract the pressing screw; and this I effect by uniting the staves which constitute the false hogsheads to bands, or hoops, of iron, which are clasped together at their ends, and when unclasped, are to spring open sufficiently far to admit of the escape of the false hogsheads over the shaft of the screw."

"What I claim, and desire to secure by letters patent, is the manner

in which I construct and employ the two false hogsheads by placing them horizontally in a range with the hogshead to be packed, and pressing simultaneously from each end, as set forth. I also claim the so arranging of the parts of the press, as that two followers may be forced up, one from each end thereof, by means of the pressing screws operated by female screws, or boxes, attached to the power wheels."

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47. For an improvement in the manner of constructing *Saw Mills;* Jeremiah Rohrer, Rohrersville, Washington county, Maryland, May 29.

In this improved mill there is one roller above, and another below the stuff which is being sawed, for the purpose of supporting it, this being necessary in sawing light stuff. The upper roller has its bearings in a piece of timber, which is hinged to another piece that slides in a suitable frame above the log. The hinged piece, with its roller, is so hung that it will yield only when the carriage runs back, but not when it is moving towards the saw. The roller may be removed from the log by means of a cord, which passes over a pulley and extends within reach of the tender of the mill. The lower end of the sliding piece, in which the lower roller has its bearings, rests upon a second sliding piece, which is jointed to a lever, to draw it away and allow the roller to slide down, the upper end of which lever is acted upon by the carriage, when the saw approaches the end of the stuff, and thus allows the saw to cut through the end of the stuff.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the manner in which I have arranged and combined the two rollers for making pressure upon the upper and lower parts of a log, when being sawed in a saw mill. I am aware that a single roller has been used for supporting a log, but this has not been made to operate in the manner described by me, nor do I know, or believe, that there has previously existed any combination similar to that herein described, by which two rollers were made to co-operate in sustaining the stuff. I do not claim, therefore, the employment of a single roller under the log; but I do claim the manner in which I have made the lower roller to operate, by causing the same to rise and fall vertically, and to be made self-operating when it is to be removed from under the log, the respective parts thereof being constructed and arranged in the manner set forth, and being used in combination with the upper roller as described."

Specifications of American Patents.

Specification of a Patent granted to Ross Winans, *for an improvement in the mode of Regulating the Waste Steam in Locomotive Engines, November 26th,* 1840.

To all whom it may concern: be it known that I, Ross Winans, civil engineer, of the city of Baltimore, in the state of Maryland, have

invented an improvement in the manner of constructing locomotive engines, by which improvement the action of the waste steam may be so regulated as to increase or diminish the draught of the furnace, at pleasure, whilst the engine is in operation and the locomotive under way; and I do hereby declare that the following is a full and explicit description thereof:

In the locomotive steam engine, as ordinarily constructed, the steam, after it has performed its office in the cylinders, is, under the name of waste steam, conducted through pipes, denominated waste pipes, into the chimney of the engine, and is suffered to escape from these pipes in a vertical direction, so as greatly to increase the natural draught through the fire, and thereby to augment the quantity of steam produced. It is a matter of great importance, however, in the arrangement of the engine, to be able to regulate the amount of this increased draught, so as to increase or diminish the power of the engine according to the various circumstances to which it is subjected when in use. It is obvious, for example, that to take a loaded train of cars up an ascending grade, requires more power than is necessary to propel it along a level, and that in a descending grade it is frequently desirable that the power should be diminished; there are other circumstances, also, as is well known to every competent engineer, under which the ability to regulate the power of the engine is not only desirable, but of vast importance.

The force with which the steam will escape from the orifices of the waste pipes, into the chimney, is determined by the elasticity of the steam, and the size of the orifices of the escape pipes; and by being able to change the latter, the velocity with which the steam shall issue may be determined, and with this, also, the augmentation, or diminution, of the draught, will be regulated. In the construction of this part of the engine, as heretofore made, it has been the aim of the builder so to proportion the size of the orifice of the waste pipes, as that the steam shall issue from them with what may be denominated a medium velocity; which, however, under the same elasticity, could not be varied, as the orifices were to remain of the same determinate size.

Now, my invention consists in a contrivance by which the engineer is enabled—in those engines in which the draught is increased by the discharge of the exhaust steam into the chimney, and while the engine is in motion—to increase or to diminish the draught in the chimney, at pleasure, by enlarging or contracting the orifice of the pipes there, so as to adapt the draught to the occasion, regulating the head of steam generated to the particular exigency.

In the engine in common use, the escape pipes, by which the steam passes from the cylinders into the chimney, are contracted in size at their upper ends, forming the orifice herein mentioned. In my invention, I propose to give them an uniform diameter throughout, say three or four inches, according to circumstances, as shown in the accompanying drawing. Where A and B, fig. 1, represent the escape pipes, and C the chimney of a locomotive, in each of these pipes I place an inverted cone, *o*, *o*, made of metal, the upper end of which terminates in a cylinder, the diameter of which cylinder is so adjust-

ed, with reference to the diameter of the escape pipe, as to allow between them, when the cone and cylinder are in the escape pipe, as small

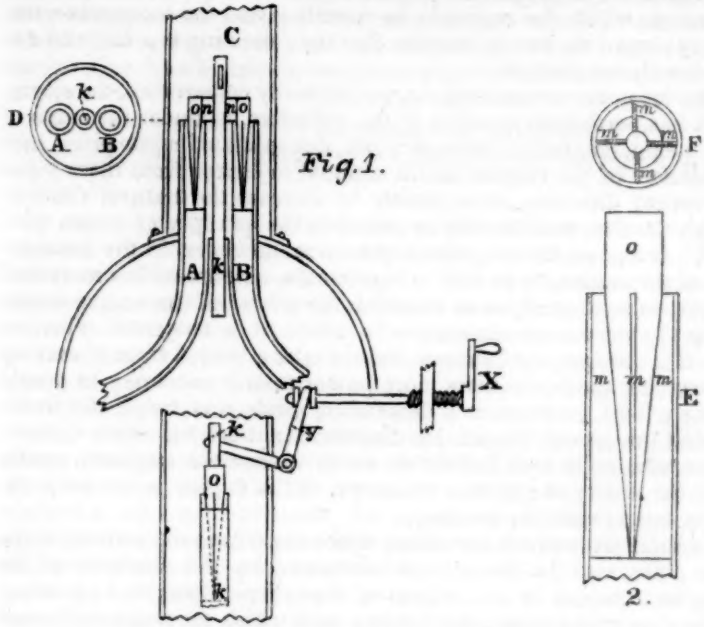

Fig. 1.

a space for the escape of the steam as is at any time allowable, so that when the cone and cylinder, which, for brevity, I term a damper, is in the position represented in the drawing, fig. 1, the steam passes into the chimney with the greatest velocity, and the draught is the greatest. It will be seen at once, by inspection of the drawing, that when the damper is raised, a part of the cone less in diameter is brought in a horizontal line with the top of the escape pipe, and the opening for the steam to pass into the chimney is increased, and that in proportion as the damper is raised, until, when the point of the damper is lifted to a line with the top of the pipe, the escape of the steam into the chimney is unrestrained by it, and of course the least increase of natural draught is obtained.

A contrivance by which the engineman can, at his pleasure, raise or lower the dampers, will enable him, therefore, to open or contract the orifices of the pipes, and, consequently, to regulate the draught according to the particular emergency. This may be effected in various ways well known to machinists. One that would answer the purpose is exhibited in fig. 1, where the engineman, by turning the winch X, moves the bent lever *y*, which, in its turn, raises, or sinks, the damper *o*. In order to steady the dampers, and keep them properly adjusted in the pipes, I affix three or four wings to each damper, extending from the apex to the base of the cone; these wings,

which consist of thin plates, stand in the direction of the radii of the horizontal section of the cone, and their outer edges touch the inside of the pipe. They are represented at *m*, *m*, in the drawing, fig. 2. To make the motion of the dampers simultaneous in both pipes, their upper, or cylindrical, portions, are connected, by extending one of the wings up the adjacent sides of said portions, so that one of the wings is common to the two dampers, as at *n*, *n*, fig. 1. Further to steady and guide the said dampers, a rod may be made to pass between the two pipes, so as to slide within a tube placed there for the purpose, as shown in fig. 1, at *k*; to the upper part of which rod, one of the arms of the bent lever already mentioned may be attached, by means of which, the dampers may be raised or lowered. D, fig. 1, is a plan showing the pipes and the tube between them, without the dampers. E, fig. 2, is a representation of the pipe enlarged, with the damper in it. F is a plan of the pipe enlarged, showing the damper and its flanches.

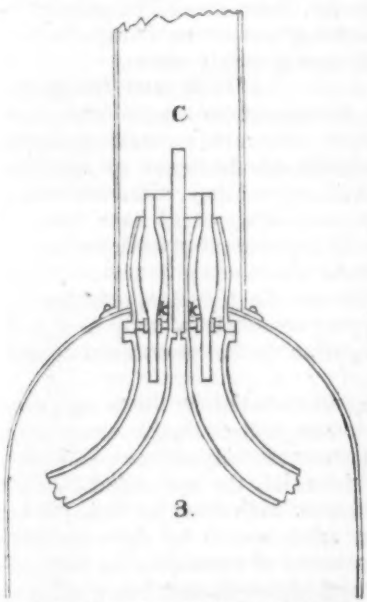

Fig. 3 exhibits a section of a chimney, and two exhaust pipes, showing another modification of my contrivance for producing the same result. The dampers here, instead of being inverted cones, are in such a form as to operate like direct cones, and the opening between them, and the sides of the pipe, instead of being the smallest that is allowable, when the dampers are depressed, is the largest; and it is by raising, not by sinking, the dampers, that the opening is decreased, and the draught increased. In fig. 3, the dampers, in place of being steadied in the pipes by flanches, as in fig. 1, are shown as steadied by a prolongation of the rod to which the bent lever is attached, downward, through a hole in a piece of metal, which is placed for that purpose, in the pipe, below the damper, as at *k*, it being so formed as to serve as a guide to the said rod, as already observed. There may be many contrivances for opening and closing the orifice of the pipes, beside the two above described; these two, however, will answer the purpose, and illustrate my object.

I do not claim the plan of increasing the natural draught, by causing the steam from the cylinders to enter the chimney, through diminished orifices; but I do claim as my invention, desiring to secure the same by letters patent, the plan of increasing or diminishing the force with which the steam from the cylinders enters the chimney, at the pleasure of the engineman, while the engine is in use, or motion, by

enlarging or contracting the orifices of the escape pipes, increasing or diminishing thereby, at pleasure, the draught of the chimney, in the manner above set forth—not intending, by this claim, to limit myself to the precise arrangement of the respective parts, as herein described, but to vary the same, as I may think proper, whilst I attain the same end, by means substantially the same.

Ross WINANS.

Practical & Theoretical Mechanics & Chemistry.

Theory of Saponification.

Aware of the importance of investigating the theories involved in the chemical arts, with a view to their ultimate improvement on scientific principles, we had formed the design of imbodying the later observations of chemists on the oily substances, when an essay of Prof. Liebig's appeared in the "Annalen der Chemie and Pharmacie," for March, 1841, which contains an excellent view of the theory of saponification; we, therefore, translate the essay, nearly entire.

J. C. B. and M. H. B.

What was known of the nature of saponification, previous to the commencement of the present century, amounted to nothing, excepting the important discovery, by Scheele, of the *sugar of fats*, now called the *hydrated oxide of glyceryl*, (glycerule.) Chevreul began, in 1813, a series of investigations on soaps, which have not only thrown a clear light on this portion of chemistry, but have also led the way to the most brilliant discoveries in the whole province of organic chemistry. We are indebted to him for the present predominating principle in all organic researches, viz: to subject a body to a series of changes, and to ground its composition on the ascertained connexion of these changes.

Chevreul proved that all fats comprehended under the terms grease, oil, and tallow, consist of three materials united in the most varied proportions, one of which, *oleine*, at common temperatures, and below 32° Fahr., is always fluid, the others solid, the one called *stearine*, the other *margarine*—distinguished from each other by their melting points, and the different acids they give rise to by decomposition. These fatty substances are each composed of a peculiar fat acid, united to a compound oxide, the oxide of glyceryl, and being salts, are subject to decomposition, like ordinary salts.

Decomposition ensues when a fat, i. e. a compound of oxide of glyceryl, is treated with an alcali, or with oxide of lead or zinc; the alcalies, or metallic oxide, combining with the fat acid—the former constituting soluble salts, or soap; the latter insoluble salts, or plasters. The oxide of glyceryl, at the moment of its separation from the fat acids, takes up water and forms hydrated oxide of glyceryl.

The weight of the hydrate of glyceryl, added to that of the hydrated fat acids, amounts to more than the weight of the fat employed; the increased weight arising from the water entering into combination with the glyceryl and fat acids.

In the saponification of fats by alcalies, no other products are formed, and the operation is conducted equally well in vacuo, or in the air. With strong alcaline lyes, the soap separates from the concentrated fluid, and collects on its surface, while the glyceryl remains dissolved in the alcaline solution. The soap remains dissolved in a weak and hot alcaline lye, but on cooling, the whole congeals to a gelatinous, translucent mass.

Soaps are *solid and hard*, or *soft*. The last are obtained from drying oils, and contain potassa as a base, and to give them more consistence, tallow and fat oils are added, which form solid soaps. The hard soaps contain soda, and are prepared with fat oils, tallow, &c.

Soda soaps are made in England and France directly by soda and fats, in Germany by decomposing potash soaps with chloride of sodium. Commercial soaps from vegetable fats consist of oleated and margarated alcalies; those from animal fats are salts of stearic, margaric and oleic acids, with an alcaline base.

Potassa and soda soaps are readily soluble in hot water and alcahol; the addition of a quantity of water to the aqueous solution produces a precipitation, the neutral salts of stearic and margaric acids decomposing into free alcali, which remains in solution and acid steorate and margarate of alcali, which precipitates in form of pearly, crystaline scales.

Potassa soaps are more soluble in water than those containing soda. Stearate of soda may be regarded as the type of hard soaps, and when in contact with ten times as much water, it suffers no striking change. Stearate of potassa forms a thick paste with the same quantity of water. Oleate of soda is soluble in ten parts of water; the oleate of potassa dissolves in four parts, and forms a jelly with two parts, and possesses such a strong affinity for water, that 100 parts absorb 162 in a moist atmosphere. Margaric acid acts similarly to stearic. It follows from this that soaps are soft in proportion to the oleates, and hard in proportion to the stearates and margarates they contain. Soda soap exhibits a peculiar behaviour to a solution of common salt; it loses the power of being penetrated by, or dissolving in, a solution of salt of a certain strength, and this remarkable action is an important condition in its manufacture, on which depends the separation of all free alcali and oxide of glyceryl, its content of water, and the state in which it is brought into the market.

If a piece of common hard soap, cut into pieces, be put into a saturated solution of salt, at ordinary temperatures, it swims upon the surface without being moistened, and if heated to boiling, it separates without foam into gelatinous flocculæ, which collect on the surface, and upon cooling unite into a solid mass, from which the solution flows off, like water from fat. If the flocculæ be taken out of the hot fluid, they congeal, on cooling, into an opaque mass, which may be pressed between the fingers into fine laminæ, without adhering to them. If the solution be not quite saturated, the soap then takes up a certain quantity of water, and the flocculæ separate through the fluid in boiling. But even when the water contains $\frac{1}{400}$ of common salt, boiling produces no solution.

If the soap be boiled in a dilute and alcaline solution of salt, and suffered to cool, it again collects on the fluid in a more or less solid state, depending on the greater or less concentration of the solution, i. e., on the quantity of water taken up by the soap. By boiling the dilute salt solution with soap for a considerable time, the watery flocculæ swell up, and the mixture assumes a foaming appearance; but still they are not dissolved, for the solution separates from them. The flocculæ, however, have become soft and pasty even after cooling, and their clamminess depends more or less upon the quantity of water they have taken up. By still continued boiling this character again changes, and in proportion as the water evaporating renders the solution more concentrated, the latter again extracts the water from the flocculæ; the liquid continues to foam, but the bubbles are larger. At length a point is attained when the solution becomes saturated; before this, large, iridescent bubbles are observed to form, and in a short time all foam disappears; the liquid continues boiling without foam, all the soap collects in a translucent mass on the surface, and now the solution and soap cease to attract water from each other. If the plastic soap be now removed and cooled, while the solution is pressed out, it has become so solid as scarcely to receive an impression from the fingers. In this state it is called *grain-soap*, (Kernseife.)

The addition of salt, or its solution, to a concentrated alcaline solution of soap in water, precipitates the soap in gelatinous flocculæ, and the mixture behaves precisely like solid soap boiled with a dilute solution of salt. Carbonated and caustic potassa act exactly like salt, by separating soap from the alcaline fluid, in which it is absolutely insoluble.

The application of the above to the manufacture of soap is evident. The fat is kept boiling in an alcaline lye until all pasty matter disappears, but the lye should only have a certain strength, so that the soap may be perfectly dissolved in it. Thus tallow may be boiled for days in a caustic potassa-lye, of spec. grav. 1.25, without saponifying; if the lye be stronger, a partial saponification takes place, but being insoluble in the fluid, it floats upon the surface in solid mass: by the gradual addition of water and continued boiling, at a certain point the mass suddenly becomes thick and clammy, and with more water a kind of emulsion is formed, (Seifenleim,) which continued heating renders perfectly clear and transparent, if a sufficient quantity of alcali be present. In this state it may be drawn into long threads, which, on cooling, either remain transparent, or are more milky and gelatinous. As long as the hot mass suffered to drop from a spatula exhibits a cloudiness, or opalescence, the boiling is continued, or more alcali added. When excess of alcali is present, the cloudiness arises from imperfect saponification, or want of water; the former is shown by dissolving a little in pure water, which becomes perfectly clear when the whole is saponified; if the lye contain lime, the mixture is also clouded, but the addition of carbonated alcali instantly clarifies it.

In order to separate the soap from water, free alcali, and oxide of glyceryl, a large quantity of salt is gradually added to the boiling

mass, on each addition waiting until it is dissolved; the first addition increases the consistency of the mass, while each successive portion renders it more fluid, till it loses its threading character, and drops from the spatula in short thick lumps. As soon as the congelation is complete, i. e., when gelatinous flocculæ separate from a clear watery liquid, the fire is extinguished, the soap suffered to collect on the surface, and cooled either on the liquid, or ladled out, and suffered to get solid.

In the former case it is impure from water, free alcali, and other impurities of the lye, and is therefore illy adapted for commerce, although sufficiently good for domestic purposes. As in other chemical operations, a precipitate is purified by boiling it in a fluid in which it is insoluble, so soap is purified by a solution of salt rendered alcaline.

The soap of the first boiling is either re-dissolved in weak alcaline lye, and precipitated by salt several times, or it is boiled with an alcaline solution of salt several times, by which means it is rendered much purer. When the saponified fluid is made with potassa, the salt (chloride of sodium) operates in a two-fold manner: it dissolves in the pasty liquid, and decomposes with the potassa salts of the fat acids, forming on the one side chloride of potassium, and on the other soda, or soda-soap. That a decomposition takes place is evident from the altered consistency of the fluid mass. Since chloride of potassium has not the property of separating soda soap, a larger quantity of salt is added. When potassa-lye is employed in soap making, the first salting requires more than twice the quantity of salt.

In the preparation of potash soaps, a concentrated potassa lye is employed for separating the soap. Acetate, or tartrate of potassa, may be employed on a small scale. In the manufacture of soaps, the saponification of the fats is not completed by the first treatment with weak lyes; and the subsequent repetition of fresh lyes, beside purifying, also renders saponification more perfect.

In saponifying olive and other oils, the mixture often attaches itself to the bottom of the vessel, and is burned; in these cases the alcaline lye is previously mingled with salt, so that the forming soap is obtained in a state of fine division, and yet prevented from forming a perfect solution. For common house use, soap of the first boil is only treated once with salt; that for commercial purposes is suffered to swell up in a weak salt lye, by means of which it takes up fifteen to twenty per cent. water. Grain soap (Kernseife of the Germans) is generally colored bluish, or greenish, from sulphuret of iron, or copper, or from iron, or copper-soaps. By cooling, these coloring matters collect more or less in certain points, which gives a marbled appearance to the hard soap. Marbling is generally produced by the addition of sulphate of iron, or peroxide of iron, to the still soft mass.

For white soap, it is rendered fluid by heating it in a saline, alcaline lye, and kept in the covered vessel until all the coloring matters have subsided. The more water the soap has taken up in this operation, the more perfect the separation of the impurities, the whiter the soap. Now, since this water is not separated, but sold in the soap,

it follows that it has much less real value than the grain soap. The white soap contains from forty-five to seventy, marbled soap from twenty-five to thirty-five per cent. water.

The manufacture of soft soap is the simplest of all. The drying oils, either alone, or mixed with train oil, tallow and other fats, are kept boiling with dilute potassa lye until the saponification is completed, i. e., a mass is formed which draws into long transparent threads. Particular care is had in its preparation to the dilution of the lye, for all soft soaps are insoluble in moderately strong potassa lye, and may be precipitated from their solution by the addition of strong lyes. The fluid would therefore appear cloudy, milky, with an excess of strong lye, and by adding water would become pasty, or gelatinous. A deficiency of alcali produces an acid oleate of potassa, which attaches itself in thick masses to the bottom of the vessel; but an addition of lye changes it into a neutral salt. Oxide of glyceryl is not separated from soap, although it might be done by the final use of strong alcaline lyes.

The soft soaps of commerce have a greenish, or greenish brown color; they are transparent in thin laminæ, shining, soft but not fatty to the touch, of a peculiar odor, and have an alcaline re-action. Tallow is often added to them, which disseminates crystaline particles of stearate of potassa; communicating to them a peculiar grained character. Chevreul and Thenard found in commercial soft soap 39.2 to 44 per cent. oleic and margaric acids, 8.8 to 9.5 potassa, and 46.5 to 52 water. They always contain hydrated oxide of glyceryl and delphinate of potassa, derived from train oil, whence their peculiar odor.

When an alcaline soap is mingled with an earthy, or metallic, salt, voluminous white, or colored precipitates ensue, in which the alcali is replaced by the earth, or metallic oxide. Thus the salts of lime, magnesia, &c., throw down lime, magnesia, &c., soaps. Hence the curdling appearance, when soap is used with hard waters, arises from the union of the lime, or magnesia, they contain, with the fat acids. If carbonate of lime be in the water, it may be thrown down by a little caustic potassa, or lime, which will render it softer; if sulphate of lime, or a magnesia salt, be present, pearlash (ash-lye) will separate the earths.

TO THE EDITORS OF THE JOURNAL OF THE FRANKLIN INSTITUTE.

Observations on Mr. Samuel Seaward's Remarks on Auxiliary Steam Power.

GENTLEMEN:—I have a few observations to offer upon Mr. Samuel Seaward's paper, abstracted from the Transactions, British Engineers, inserted in your valuable Journal for December, 1841, and in the American Repertory for December, 1841, which will shew how necessary it is to examine, and to separate the theoretical remarks from the facts in that paper.

At page 412, vol. ii, 3rd series, Journal Franklin Institute, Mr. Seaward remarks, "A quadruple increase of power will not produce

double the original velocity of a steam ship, although in theory such is assumed to be the case, for as the weight is more than doubled, the immersed section becomes greater, and a still further increase of power becomes necessary."

In this quotation, obscure though it be, it does not in the least appear that Mr. Seaward intended to say, that quadruple power will be insufficient to produce double the original velocity in a steam ship having the same immersion; but on the contrary, he supposes that quadruple power was sufficient, yet in the table calculated by Mr. Cubitt, and appended to Mr. Seaward's paper, it is assumed throughout, that eight times the power is required to produce double velocity in a steam ship, having the same constant immersion.

Thus in one quotation, four times the power, and in the other quotation eight times the power, is assumed to be necessary to produce a similar effect.

As this question is important, and can so easily be mechanically determined by experiment, it is very singular it should remain undetermined, as it is the fruitful parent of many absurdities, and surely none can be greater than one lately advanced, namely, that the resistance to vessels moving in water increases as the square of the velocities, but the power requisite to overcome that resistance, increases as the cube. Such contradictory statements, however eminent their authors, cannot be deemed either luminous, instructive or creditable.

Presuming your wish is to uproot error, and to increase the sum of knowledge, I beg to offer you the following experiments, to set this subject at rest.

Having at hand a small, but broad, cistern, I caused two short and heavy model boats to be drawn through the water by different weights attached to threads, passing under and over appropriate pullies, and found that when one boat had passed over a certain space, the other boat, drawn by a double weight, had passed over double space—or over double the space the first boat had passed over, in the same time; and I found corresponding effects produced when lighter, or heavier, weights (similarly proportioned) were employed.

As in all these cases the double weights descended double distances in the same time, double weight, multiplied by double descent, was equal to the expenditure of quadruple power for double velocity of the model boat.

These experiments having been very rudely questioned, because made on a small scale, I repeated them in a larger, but narrower, cistern, when at first I was surprised to find that 2.25 times the weight was required to draw one of the boats through double the space, that was required to draw the other boat in the same time, thus 4.5 times the power was required to obtain double velocity in a narrow cistern.

The extra resistance I soon found was occasioned solely by the undue accumulation of water in front of the fastest boat, for on substituting narrower boats in the narrow cistern, a weight of 2⅛ was sufficient to produce double velocity of one boat in a narrow cistern, and on repeating the experiments in an open pond of water, where, by the use of lines upon drums of different diameters, supported upon elevated frames, so that the descent of the weights through one foot, drew

the boats through four feet, the extended results thus obtained, corresponded with those at first obtained in the wide cistern, namely, the descent of a double weight through a double space, caused the one boat to travel through twice the distance the other did, in the same time.

These experiments, then, prove alike, that quadruple power is required, and that quadruple power only is required to produce double velocity in a boat in open water, and also proves that double speed is twice as costly, and only twice as costly, as single speed, for an equal distance, in any vessel maintaining the same degree of immersion; because though four times the power is expended in a given time, yet the speed being doubled in that time, the actual power expended is but doubled also, because the quadruple expenditure of power is of only half the duration of the single expenditure.

The same results are obtained in another form, in the following experiments:—

A pair of paddle wheels were formed of tin plate, twelve and a half inches in diameter, on an iron axis two feet long, one half inch turned bearings to ditto, and a wooden drum, two inches diameter, thereon.

Each wheel (having sixteen floats, four inches long, by one and a half inches deep,) was immersed in water about two inches, and the wheels were then made to revolve by a cord, one end of which was wound on the drum, and the other end of the cord passed over a pulley suspended to the roof of a building.

When different weights were attached to the cord, the descent of each weight from the pully to the floor of the building, caused the paddle wheels to revolve a constant number of times, at different speeds, the times occupied by the different weights in their descent was ascertained by the oscillations of a pendulum.

Descent of weights during oscillations observed:

Of 2 lbs.,	67
4 lbs.,	+33
8 lbs.,	+16
16 lbs.,	+ 8

Thus in all those cases, double weights descending through double space, or quadruple power, caused the paddle wheels to revolve with double velocity in a uniform depth of water.

Could any farther evidence be required, that double velocity of a steam ship is acquired by the expenditure of quadruple power, it is to be found in the diagram of the Great Western steamer, vol. ii, page 274, of the American Repertory, and in the table and details thereof, pages 406 to 408 of the same volume, to which the writer has appended the following remark, and with a quotation thereof will conclude the present communication:—

"We ought to consider it a very fortunate circumstance that the steam engine has become its own commentator, we thus obtain certain facts unalloyed by prejudices or conceits, a concurrence as rare as valuable." I. F.

Brooklyn, N. Y., May 31*st*, 1842.

Remarks on Evaporation in, and Incrustation of, Steam Boilers.

Mr. C. W. Williams has read a paper before the Victoria Gallery, Manchester, upon the evaporation in, and incrustation of, boilers, in which he has endeavored to show that the destruction of the plates by the fire is not caused by the saline, or other permanent, incrustations, but by the muddy deposits which settle after the ebullition is over.

To prove this he exhibited experiments, showing that the incrustations were nearly as good conductors of heat as the metal of which the boilers are made, but that the muddy deposits are non conductors, and argues that as the incrustations will transmit the heat nearly as fast as the metal, that therefore they cannot cause its destruction. It does not appear that this conclusion is well founded, because although plates of iron, of usual thickness, will transmit the heat from the fire to the water as fast as generated, it does not follow that the same power exists when the plate is increased to an undue thickness. Suppose a boiler constructed of two or more plates, rivetted together—which would be a parallel case to a plate lined with one or more layers of incrustation—the effect would be, as is known from experience, to destroy the outer plate. What engineer has not seen the effect of a patch over the fire, when the internal plate has not been cut through, to admit the water to the inner surface of the new piece? We would scarcely advise engineers to depend upon the theory of Mr. Williams, in this particular, but to keep the boilers well freed from sediments of all kinds.

Mr. W. made some judicious remarks upon the necessity of keeping the plate always in close contact with water. He instanced a case where the water had been prevented from touching the plate by violent ebullition, and presented a sample taken from the water leg of the steamer Liverpool. The leg, though situated in the lower part of the boiler, between the furnaces, was so narrow that the heat from the adjacent fires drove the water entirely from between the plates, so that when an aperture was made steam only escaped. This is a fact of great importance, showing the necessity of making the passage, or leg, between the furnaces, of sufficient width to ensure a full supply of water. For the purpose of obtaining an enlarged grate surface, engineers are but too apt to contract the intermediate space and thereby incur a great risk of destruction to the leg sheets. It is, probably, one of the causes of the more rapid decay in the legs of our river and sea boats, than in any other part of the boiler.

The Liverpool's furnaces were four feet seven inches long, and five feet three inches deep; and the leg was a simple passage between them, probably not more than four inches wide, and when an intense fire existed, there was not sufficient space for the free circulation of the water. Four, or four and a half, inches, would have given ample space for the outer leg, to which the heat comes in contact only on one side; but the middle legs should not have been less than seven or eight inches in width.

Notice of Porter & Co.'s Patent Anchors.

Through the politeness of our London Correspondent, we have been favored with a copy of a pamphlet, issued by Porter & Co., of Dunston Iron Works, near *Newcastle-on-Tyne*, descriptive of the results of a number of practical tests to which their *patent anchors* have been subjected, by various officers of the Royal Navy, by pilots on the Coast of England, and by other mariners. From this pamphlet we shall extract the substance, for the information of our readers.

Few instruments now in use can justly lay claim to such high antiquity as the anchor; it clearly antedates the Christian era, and its origin is in fact so very ancient, as to be deeply involved in obscurity, though we believe its invention has usually been ascribed to the Tuscans.

The anchor, nearly in the same form as that in which it is at this day used, has been for ages employed; and although numerous attempts have, from time to time, been made to improve it, their practical success has not been great, and its general shape has remained almost unaltered; though within the last twenty years—since the general introduction of chain cables for shipping—it has been made shorter and stouter than formerly, whilst the stocks of chain anchors are usually made of iron, and so secured, by a forelock, that they can at pleasure be turned parallel to the shank, when the anchor is stowed inboard. On the other hand, when cables of hemp were more generally used, the stocks were fixed in their position, and formed of wood.

The year 1822 seems to have been prolific of inventions designed for the improvement of anchors—at least four distinct patents having passed the great seal of England, in that year, for various alterations in the form and mode of constructing them; of these, three had revolving flukes, and in one of the forms, patented by William Piper,* the flukes turn upon a bolt passing through the crown, as is the case with those we are about to describe, and, like them, the proper angle was to have been given to the entering fluke, by the revolution of the other, until its point, or bill, closed upon the shank, as in the *patent anchor* of Porter & Co.; (see fig. 3,) but as the latter is differently stocked—though identical in the principle of its fluke action—it is sufficiently distinct in form to be classed as a separate invention; besides, Porter & Co. have the merit (not, we believe possessed by the other,) of having brought their anchor into successful practical use, by freely submitting it to the test of actual experience at sea, under almost all the circumstances which commonly affect an anchorage: this test the anchor in question seems to have borne in a manner very satisfactory to the seamen by whom it was used.

Lieut. Rodgers, of the Royal Navy, and many other ingenious men, have at various times exerted their inventive talents in bringing forward new forms, or methods, of constructing anchors, but thus far without having superseded, to any great extent in practice, the ordinary form with which every one is familiar; whether the *patent anchor* of Porter & Co. will meet with the same fate as its predecessors, is a question which time and experience can alone determine; all that the latter yet justifies us in declaring is, that *it fairly promises*

* London Journal of Science and the Arts, (Newton's) vol. v, page 248.

to become a valuable substitute for the common anchor, especially in the naval service.

As it is unnecessary for our present purpose to enter into farther detail upon this subject, we will now proceed to speak more particularly of the *patent anchor* of Porter & Co., referring to their descriptive pamphlet as our text.

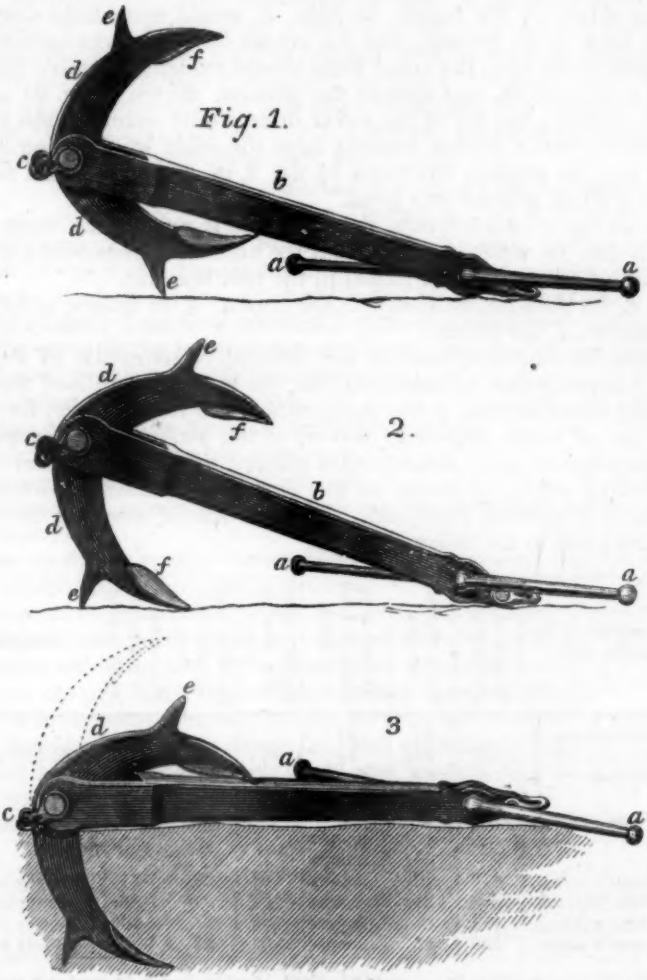

Fig. 1, represents the *patent anchor*, as it would probably rest upon the bottom, when first let go from a vessel.

Fig. 2, represents the position which the *patent anchor* would take at the first check it received from the cable.

Fig. 3, represents the position which the *patent anchor* would assume, in good holding ground, when fully strained by the cable.

We will here remark, in connexion with the illustrative cuts, that

the spurs, *e*, *e*, (fig. 2, &c.) seem indispensable to the successful action of the *patent anchor*, as without them, if the joint at the crown, *c*, should happen to be stiffened by rust, or any other cause, the anchor might readily slide along on the back of the fluke *d*, and come home without taking hold of the ground at all.

But it must be evident that this cannot happen when the spur *e* is attached to the fluke, for, from the weight of the anchor itself, as well as the shape of the toggle, or spur, it would immediately enter, or seize hold of, the ground; and the instant the cable was tightened, by the drift of the ship, the lower fluke would evidently revolve upon the spur *e*, as a pivot, and assume the position shown in fig. 2; *once in that position*, the bill of the lower fluke would enter, (if the ground admitted,) and a further draught upon the cable would bring the anchor into the position exhibited by fig. 3, in which it would remain, if the holding ground was good.

In all the illustrative cuts, the same letters refer to the same parts, and it may be well to remark, that the anchors represented are made wholly of *wrought iron*, forged in the best manner.

a, *a*, the stock; *b*, the shank; *c*, the crown; *d*, the flukes; *e*, the spurs, or toggles; *f*, the palms.

From documents quoted in the descriptive pamphlet of Porter & Co., it appears that a common anchor (on Pering's plan)—of the usual quality manufactured in the dockyards of the Royal Navy, for a first rate line of battle ship—and several of the *patent anchors*, were, in the presence of many distinguished officers, submitted, successively, to a breaking strain, by means of the powerful hydraulic proving machine, in Woolwich Dockyard. Of these trials of strength, the results are compiled in the following table.

Description of the anchor tried.	Weight of anchor in pounds	Strain imposed in tons.	Deflection in inches at point of fluke.	Regular admiralty proof in tons.	Breaking weight of anchor in tons.	Ratio of weight of anchor to breaking weight	Remarks.
1. Common anchor, of a 120 gun ship.	10847	60	2¾	65	68	1-1 4	Steady pull.
		66¾	4½				
		68	Unknown				
		14	Unknown				
2. Porter's patent.	3136	20	⅞	27	60½	1-43	Steady pull.
		27⅞	Unknown				
		60½	Unknown				
3. Porter's patent.	616	20½	Unknown	8⅝	20½	1-74	Steady pull.
4. Porter's patent.	560	21½	Unknown	8½	21½	1-86	Strain by jerks.
5. Porter's patent.	381	17	Unknown	5⅝	17	1-100	Steady pull.
6. Porter's patent.	620	27	Unknown	9	27	1-97	Steady pull.

It further appears, by our text, that Porter & Co.'s *patent anchors* have been more or less used in the Royal Navy for nearly three years, and that by order of the Lords Commissioners of the Admiralty, some *forty-five sail* of vessels belonging to the British navy, have recently been equipped with these *patent anchors*.

Previous to taking this step, however, the Admiralty, in the year 1841, pursuant to a request made of them by Porter & Co, caused

patent anchors (at the risk and expense of the patentees) to be simultaneously placed on board of some ten or twelve sail of her Majesty's cruisers, employed upon the coasts of England; and they instructed the commanders of these vessels to test the new anchors, in every possible manner, and report the results, *after three months actual service.*

The reports made under the orders alluded to, by these officers of the Royal Navy, concerning their anchorage with the *patent anchors*, in almost every kind of holding ground, *were uniformly favorable;* and to avoid repetition, we will here subjoin but three of these, (addressed by permission to the patentees,) viz: *one* from Commander Denham, R. N., and *two* from Mr. Thomas, a master in the navy, commanding H. M. surveying ship, the *Mastiff.*

Marine Surveyor's Department,
Port Fleetwood, Jan. 1, 1842.

Having had under trial, Porter's Patent Anchors, and subjected them to the most treacherous holding ground, great tidal jerks, and effect of eddies, as well as working round by steam paddle, *to foul them if I could;* I am now enabled to state that anchors so constructed will present to the mariner the combined essentials so long looked for. I need only enumerate the following:

It is almost impossible to foul it.

It bites quickly into the most stubborn ground.

It holds on to the shortest stay-peak.

It cannot well lodge on its stock end.

It presents no *upper* fluke to injure the vessel herself, or others, in shoal water.

It cannot injure vessels' bows when hanging a cock-bill, as merchant vessels find a convenient practice.

It is not so likely to break off an arm, or part in the shank, as anchors with fixed flukes do, because the construction of these arms can be of continuous rod iron, and the leverage is so much nearer the ring, owing to the pea of the upper fluke closing upon the shank.

It is a most convenient anchor for stowing in-board on a voyage, as the flukes can be easily separated, and passed into the hold; it can as easily be transported by *two* boats, when one would be distressed with the whole weight.

It produces the desired effect of ground tackle, at less weight.

Wishing it *general adoption*,
I remain yours truly,
H. M. Denham, Com. R. N., F. R. S.
Consulting Marine Surveyor.

Her Majesty's Surveying Ship "Mastiff,"
Woolwich, February 18, 1842.

Gentlemen—I received your letter of the 12th January, enclosing another from the Lords Commissioners of the Admiralty, authorizing me to give an opinion of the merits of your Patent Anchors, which have, by their sanction, been put on board her Majesty's ship under my command, for trial, between the year 1839 and the present

time; in order to do which, it will be necessary to detail all the circumstances attending them from the time they were embarked.

In 1839 your anchor, which was put on board, weighed only 8 cwt. 1 quarter, when the *Mastiff's* small bower anchor weighed 13 cwt.; with this discrepancy, added to a little prejudice in favor of our old forlorn hope, rendered me incapable of reasoning myself into the belief that your anchor was strong enough in the crown to hold the ship, or that it would bite the ground so quick as recent experience has taught me. Impressed with these ideas, and the ship being employed in a survey of the Orkney Islands, where she is compelled to anchor in narrow and intricate channels, in strong tides and eddies, surrounded by dangers, your anchor, gentlemen, was reserved for trying its merits in a wider space, where there was room to retreat in safety should it break: an opportunity offered of so doing on the 28th of November in the same year, when it was let go in 12 fathoms water, off Aldborough, with Orford Lighthouses in one; there was a fresh breeze, and considerable sea running at the time; by the time 29 fathoms of cable had been veered out, to our astonishment and agreeable surprise, the ship brought up and swung to the tide, when 60 fathoms of cable was given her; on the return of the weather tide, the ship was pitching her bows under water, and the wind had freshened, so much so, that with the force of forty men some difficulty was found to heave the ship a-head to stay a peak, yet this small anchor tenaciously held its gripe, until the topsails were filled, with the view of either breaking it or tearing it from its bed; we succeeded in doing the latter, and hove it up to the bows, not as we anticipated, with both flukes gone, but in good order, covered with mud and clay to the stock. This *first trial* did away with my former prejudice against it, and led me to apply for a larger anchor for trial; my application was met by you, gentlemen, putting on board, in the Frith of Forth, one of your Patent Anchors of 13 cwt., which was immediately taken to the bows, in lieu of one of the ship's bowers, and applied to use, the merits of which you will receive in my next letter.

I am, gentlemen, &c.
GEO. THOMAS, R. N.,
Master Commanding, and Marine Surveyor.

Her Majesty's Surveying Ship "Mastiff,"
Woolwich, February 23, 1842.

GENTLEMEN—Your Patent Anchor, weighing 13 cwt., which was received on board her Majesty's ship under my command, for trial, in April, 1820, was put into use the day it was embarked; it was let go in six fathoms water, off St. David's, in the Frith of Forth, and, by the time that 12 fathoms of cable was veered out, the ship was brought up, and the clasping of the upper fluke to the shank, was sensibly felt on board. At the expiration of three days an attempt was made to weigh it, but it had buried itself so deep in the mud, that, after heaving-to short a-peak, we were compelled to wait the rising of the tide to drag it from its bed; it was subsequently used until the month of November in the same year, in various parts of the Orkney Islands,

the ship anchoring every day on soils of mud, sand, stones, and a compound of the three; in no one instance did she drift or foul her anchor, nor was any precaution taken to prevent her so doing, but quite the reverse. Its unqualified merits and superiority, over all other anchors, was reported to the Lords Commissioners of the Admiralty. On our return to Woolwich, the above anchor was put on board her Majesty's ship *Albert*, at the request of Captain Trotter, to be used on her voyage to the Niger. In my next I shall relate to you, gentlemen, the merits of your Patent Anchor put on board this ship, for trial, in 1841.

I am, gentlemen, &c.
GEO. THOMAS, R. N.,
Master Commanding, and Marine Surveyor.

In addition to *sixteen* officers of the Royal Navy, as many masters of merchantmen, together with the pilots of the port of Deal, have all united to bear a favorable testimony to the valuable properties possessed by the anchors in question—all of these mariners having either ridden by them in their own vessels, or witnessed their successful holding in gales of wind, under a variety of circumstances. *The bulk of this evidence is, therefore, experimental.*

Porter & Co. have certainly brought forward a most forcible mass of important testimony in favor of their *patent anchors*, yet still there are a few objections, which may with propriety be urged against them.

Thus Captain John Washington, R. N, says:—"Were I to seek for objections, they would be, first, that the anchor supplied to the *Shearwater* was not easy to fish; this the patentee, by his recent improvement of placing a shackle on the lower part of the shank, has, I trust, completely remedied. Secondly, that in case of loss without a buoy-rope (which steamers never use,) it is very difficult to sweep. Thirdly, that letting go the anchor on a rocky bottom, it seems possible, *but improbable*, that the cheeks, or "lugs," of the shank, might strike a rock, and appearing the weaker part, snap; but this also has, I understand, been remedied."

To these objections we may add, that, from the testimony of Mr. Thomas, the commander of the *Mastiff*, given in the letters already quoted, it appears that under some circumstances, *these anchors hold too well.*

Some persons may smile at such an objection as this, but it must be recollected that *in the merchant service* the crews are usually small—that merchantmen cannot afford to leave their best bowers wherever it is necessary to anchor by them—that it is almost as requisite that an anchor should admit of being weighed with ease, as that it should hold well when down—in short, it seems that in cases like those stated by the Commander of the *Mastiff*—where he was obliged, in one instance, to fill his topsails for the purpose of loosening a small bower anchor (of Porter & Co.'s patent) from the ground, after heaving upon it in vain with *forty men;* and in another, after bringing the anchor short a-peak, * to await the rising of the tide, to break it out—

* That is, bringing the cable perpendicular from the anchor to the bows of the ship.

a merchant ship, *manned as usual,* would, probably, have been unable to get her anchor at all, on either of the occasions referred to. Now if this be not a real objection, we submit to those acquainted with nautical affairs, whether, at the least, *this very tenacious holding* will not sometimes be productive of great inconvenience.

Captain Washington's objection, that the *patent anchor "is very difficult to sweep,"* is a pretty strong one, for it is well known that many anchors have been recovered in this way, which would otherwise have been totally lost. The common anchor, when fixed in the bottom, has always one fluke projecting upwards; this affords great facilities in the operation of sweeping, which is generally so successful that it is actually followed as a business, by persons upon our seaboard, who may every summer be seen sweeping at random the exposed roadsteads along the Atlantic coasts, in which operation so many lost anchors are caught, as to make it frequently *a very profitable business:* a glance at Fig. 3, will show, that whenever the upper fluke has closed down upon the shank, an attempt to sweep the *patent anchor,* by the usual process with the bight of a hawser, *would be almost hopeless.*

Again it appears to us, that the additional surface exposed to oxidation by the *patent anchor,* at the junction of the shank and flukes, and the probable wearing and breaking of the fluke bolt at the crown from frequent use, are likely to be objectionable.

We must not, however, omit to notice—what the experiments above recited already prove—namely, that the *patent anchor* gains much strength from being in two separate pieces, as it admits of being forged in a compact and solid manner, and avoids the great practical difficulty in the common anchor of successfully welding the shank and flukes together, at the crown, *in such a manner as to be safe;* almost all the common anchors are unavoidably weak in this part, and it is a high merit in the *patent anchors* that, unlike the others, no practical objections exist to their being as well and solidly made as the material will admit.

In conclusion, we feel bound to observe, that the advantages promised by the *patent anchor*—as reported upon by the British naval officers—so far outweigh any objections which occur to us at this time, that we cordially recommend it to the consideration of our merchants—of the mariners in their service—*and, especially, we commend it to the attention of the superior officers of the navy of the United States.*

The Meteorological Table is omitted for want of room, but will appear in the next number.